DATA TRANSLATION

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DT7837
User's Manual

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Radio and Television Interference

This equipment has been tested and found to comply with CISPR EN55022 Class A and EN61000-6-1 requirements and also with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

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Note: This product was verified to meet FCC requirements under test conditions that included use of shielded cables and connectors between system components. It is important that you use shielded cables and connectors to reduce the possibility of causing interference to radio, television, and other electronic devices.

Canadian Department of Communications Statement

This digital apparatus does not exceed the Class A limits for radio noise emissions from digital apparatus set out in the Radio Interference Regulations of the Canadian Department of Communications.

Le présent appareil numérique n'émet pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques de la class A prescrites dans le Règlement sur le brouillage radioélectrique édicté par le Ministère des Communications du Canada.

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About this Manual

The first part of this manual describes how to install and set up your DT7837 module and verify that your module is working properly.

The second part of this manual describes the features of the DT7837 module and how to program the DT7837 module using Linux system calls. Troubleshooting information is also provided.

Intended Audience

This document is intended for engineers, scientists, technicians, or others responsible for using and/or programming a DT7837 module for data acquisition operations in the Linux operating system. It is assumed that you have some familiarity with data acquisition principles and that you understand your application.

How this Manual is Organized

This manual is organized as follows:

- Chapter 1, "Overview," describes the major features of the DT7837 module, as well as the supported software and accessories for the module.
- Chapter 2, "Principles of Operation," describes all of the features of the DT7837 module.
- Chapter 3, "Troubleshooting," provides information that you can use to resolve problems with the DT7837 module should they occur.
- Chapter 4, "Calibration," describes how to calibrate the analog circuitry of the DT7837 module.
- Appendix A, "Specifications," lists the specifications of the DT7837 module.
- Appendix B, "Connector Pin Assignments and LED Status Indicators," lists the pin assignments of the connectors on the DT7837 module, and describes the LED status indicators on the DT7837 module.
- An index completes this manual.

Conventions Used in this Manual

The following conventions are used in this manual:

- Notes provide useful information or information that requires special emphasis, cautions provide information to help you avoid losing data or damaging your equipment, and warnings provide information to help you avoid catastrophic damage to yourself or your equipment.
- Items that you select or type are shown in **bold**.

Related Information

Refer to the following documents, which can be found on the DT7837 web page on our website (http://www.datatranslation.com/products/dataacquisition/embedded/DT7837/) for more information on using the DT7837 module:

- *DT7837 Getting Started* help file
- *DT7837 File I/O Programming Manual*

Refer to your Linux documentation for more information about Linux and Texas Instruments documentation for more information on the TI Sitara AM3352, 1 GHz, ARM® Cortex-A8 processor.

Where To Get Help

Should you run into problems installing or using a DT7837 module, the Data Translation Technical Support Department is available to provide technical assistance. Refer to Chapter 4 for more information. If you are outside the United States or Canada, call your local distributor, whose number is listed on our web site (www.datatranslation.com).

Overview

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Hardware Features

The DT7837 module is an open-source Linux computing platform with a high-accuracy, dynamic signal analyzer front-end, making it ideal for embedded applications that require noise, vibration, and acoustic measurements.

The module is composed of two boards (the bottom board contains the ARM block and the top board contains the I/O block) that connect together, as show in Figure 1. Users can embed the module into their own enclosure and/or system, as needed.

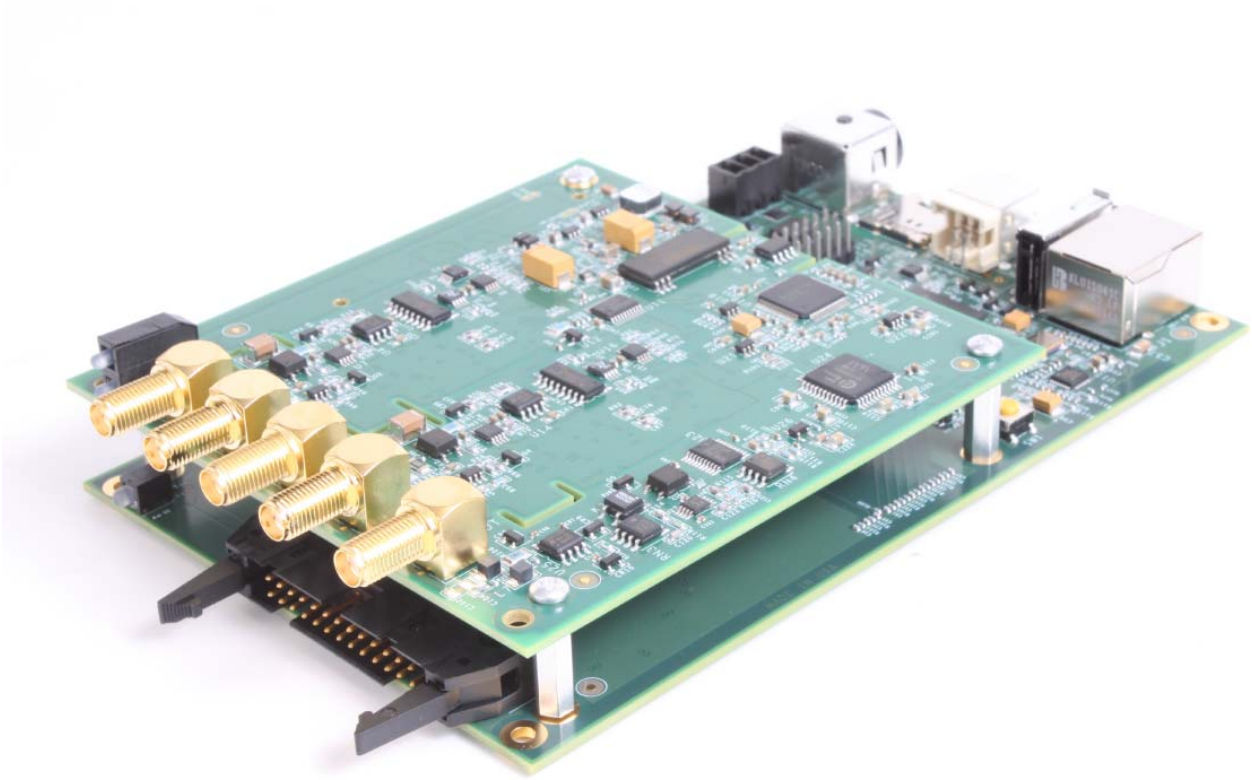

Figure 1: DT7837 Module

The key features of the DT7837 module are as follows:

- Open-source computing platform featuring a TI Sitara AM3352, 1 GHz, ARM® Cortex-A8 processor.
- Linux distribution consisting of a Linux kernel, bootloader, and file system with a DT7837 device driver, USB device (client) driver, and USB host driver.
- Ethernet 10/100 Mbps connectivity to a host computer.
- USB 2.0 full-speed connectivity to a host computer.

- USB 2.0 host connection to external devices, such as a mouse, keyboard, or external storage devices.
- Analog input subsystem:
  - Four, single-ended analog input channels available through SMA connectors.
  - Four simultaneous sampling, Delta-Sigma, 24-bit analog-to-digital converters (ADCs).
  - Support for IEPE (Integrated Electronic Piezoelectric) inputs, including use of a 4 mA current source with 20 V compliance voltage for AC or DC coupling.
  - Programmable throughput rate from 195.3125 Samples/s to 105.469 kSamples/s.
  - Input range of ±10 V with software-selectable gains of 1 and 10 for an effective input range of ±10 V and ±1 V.
  - Continuous acquisition from multiple analog input channels simultaneously.
  - Supports the ability to return the value of the tachometer, general-purpose counter/timer, measure counter, and/or digital input port in the analog input data stream, allowing you to measure a variety of signals synchronously with analog input measurements.
  - Software-programmable trigger source (software trigger, external trigger, or threshold trigger using any analog input channel) to start acquisition.
  - Accounts for analog input group delay in hardware and allows user-specified trigger delay to account for analog output group delay.
- Up to eight, TTL digital input lines using the eight general-purpose inputs. You can read the digital input port directly or you can return the value of the digital input port in the input data stream.
- Up to eight, TTL digital output lines using the eight general-purpose outputs. You can write a value to the digital output port directly.
- One, 32-bit, general-purpose counter/timer for performing event counting, rate generation, and non-repeatable one-shot operations. You can use two general-purpose input signals for the C/T clock and gate inputs and one general-purpose output signal for the C/T clock output. You can read the value of the counter/timer directly or through the input data stream.
- One tachometer input signal. The value of the tachometer input signal can be returned in the input stream.
- One phase/measure counter. You can program the edge that starts the measurement and the edge that stops the measurement. Many edge types are supported. The data from the measure counter can be returned in the input stream.
- 2 GB embedded NAND flash memory that contains the Linux kernel, bootloader, and file system; this memory can also be used to store user files and data
- 512 MB SDRAM (DDR3) memory
- 8 kBytes EEPROM
- Micro SD connector supports micro SD cards, which can be used as a boot source for general-purpose file and data storage
- 3.3 V UART, I2C, and an SPI (Serial Peripheral Interface) interfaces for embedded connectivity.

- Serial debug port.
- External power connectors (4-pin DIN or 3-pin Phoenix header) for connecting a +5 VDC power supply.

Board Layout Overview

The DT7837 module consists of an ARM block and a I/O block. Figure 2 shows the layout of the ARM block (the bottom board). Figure 3 shows the layout of the I/O block (the top board).

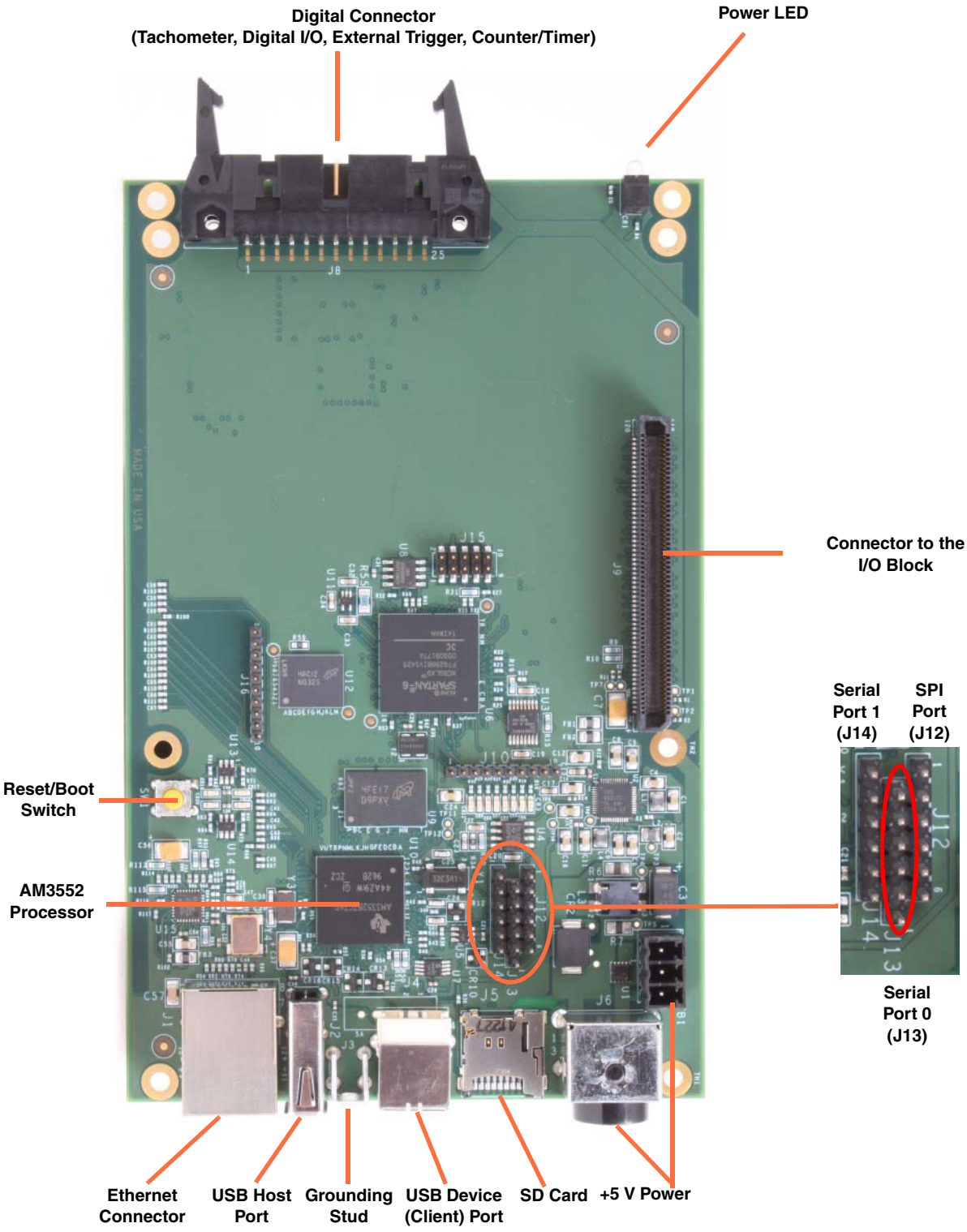

Figure 2: Layout of the ARM Block of the DT7837 Module

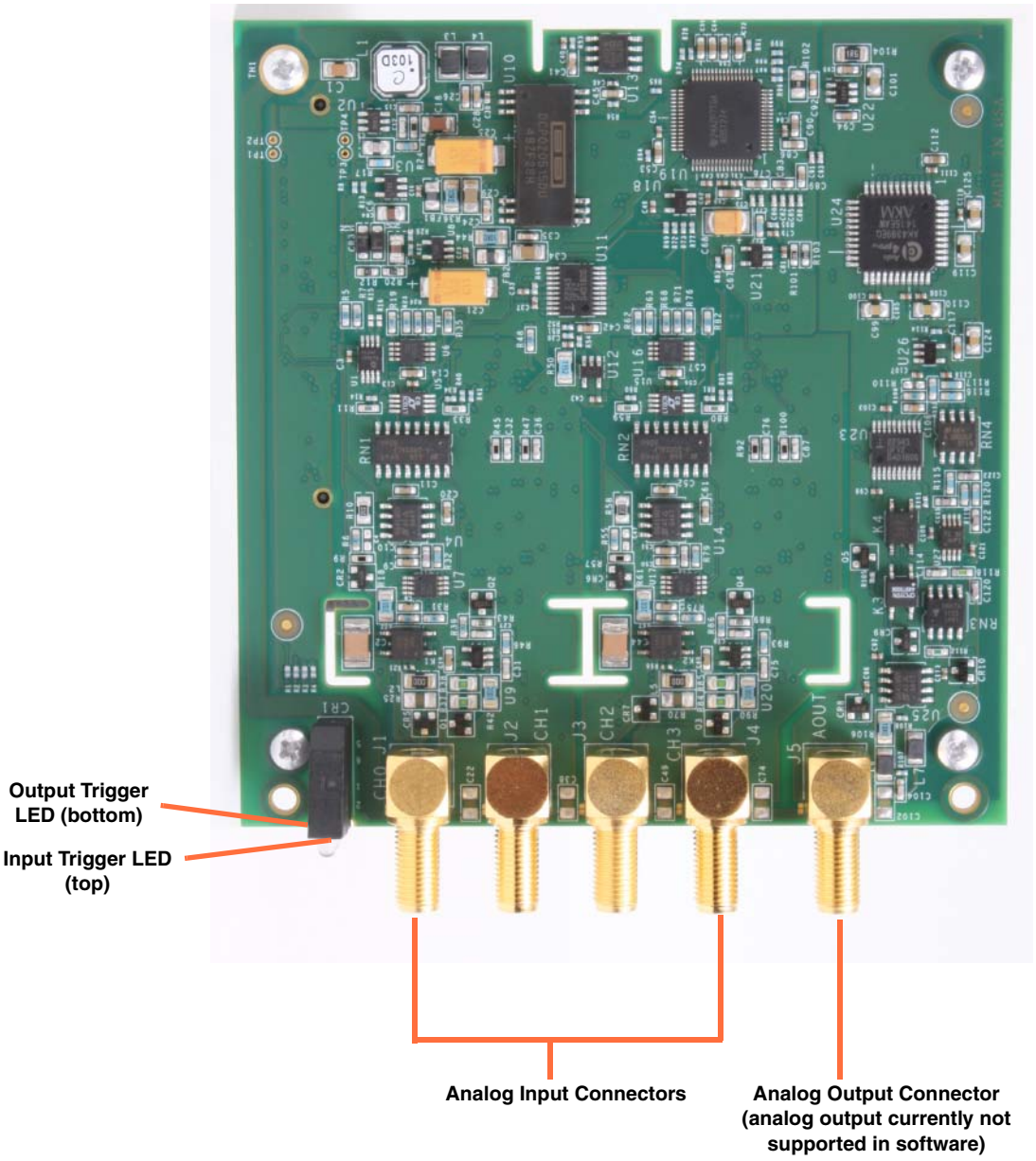
Output Trigger LED (bottom)
Input Trigger LED (top)
Analog Input Connectors
Analog Output Connector (analog output currently not supported in software)

Figure 3: Layout of the I/O Block of the DT7837 Module

Supported Software

The following software is available for use with the DT7837 module:

- **DT7837 File I/O Commands** – A set of commands in Linux user space for opening a subsystem or stream, configuring a subsystem or stream, acquiring data in the input stream, reading or updating the digital I/O port, and/or writing values to the calibration potentiometers. Numerous example programs are provided to illustrate how to use these commands. Refer to the *DT7837 File I/O Programming Manual* for more information.
- **DT7837 Kernel Device Driver** – The device driver resides in the Linux kernel and is responsible for performing the functions defined by the DT7837 file I/O commands on the DT7837 module.
- **DT7837 Calibration Utility** – This utility, described in Chapter 4, allows you to calibrate the analog circuitry of the DT7837 module.

Supported Accessories

The following optional accessories are available for a DT7837 module:

- **STP26 screw terminal panel** – This screw terminal panel accepts tachometer, digital input, C/T gate input, and C/T clock input signals from the Digital connector on the DT7837 module and provides digital output and C/T clock output signals from the Digital connector on the module.

  The 26-pin, 36-inch, EP406 cable is included with the STP26 screw terminal panel. The cable allows you to attach the STP26 screw terminal panel to the Digital connector on a DT7837 module.

  Figure 4 shows the STP26 and EP406 cable.

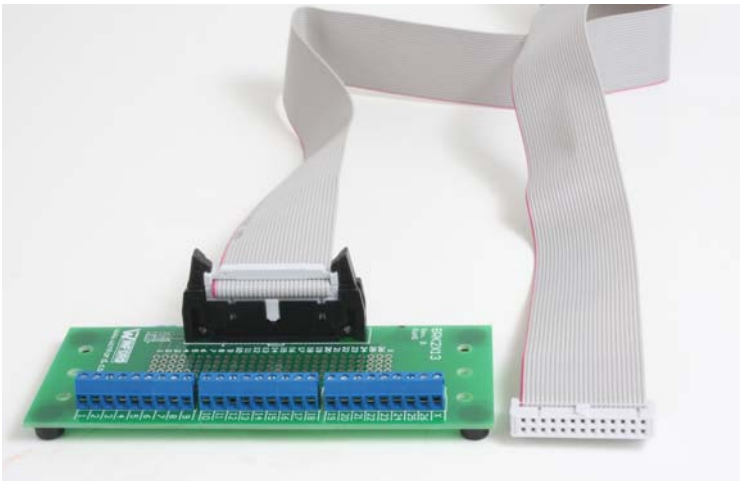

Figure 4: STP26 Screw Terminal Panel and EP406 Cable

- **EP405 USB to Serial TTL Debug Cable –** This 3Mbaud, 1.8 m cable, shown in Figure 5, connects the USB port of the host computer to serial UART connector J13 on the DT7837, allowing you to debug the DT7837 using a terminal interface.

Figure 5: EP405 USB to Serial TTL Debug Cable

- **EP361 External Power Supply** – This +5 VDC optional power supply and cable, shown in Figure 6, connects to the DIN power connector on the DT7837 module and to the wall power outlet.

Figure 6: EP361 +5 VDC External Power Supply

Getting Started Procedure

Refer to the DT7837 Getting Started help file on our web site (http://www.datatranslation.com/products/dataacquisition/embedded/DT7837/) for getting started information

2

Principles of Operation

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Block Diagram

The DT7837 is an open-source Linux computing platform with a high-accuracy, dynamic signal analyzer front-end.

The DT7837 consists of two boards. The bottom board is the ARM block, which includes the ARM processor, PC and embedded connectivity options, and memory, as well as the digital I/O, counter/timer, measure counter, and tachometer circuitry.

The top board is the I/O block, which includes four 24-bit IEPE analog inputs and one 24-bit stimulus analog output.

Note: The analog output circuitry is currently not supported in software.

Figure 7 shows a block diagram of the DT7837 module.

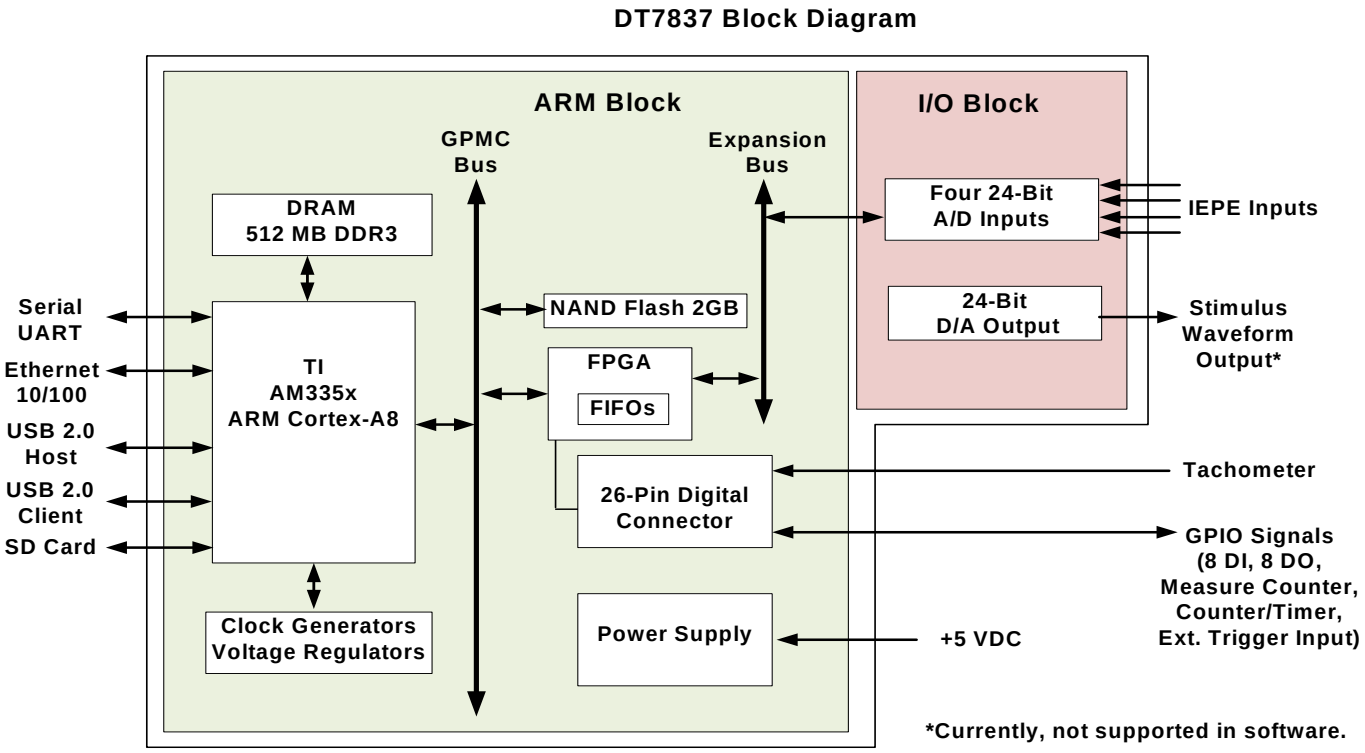

Figure 7: Block Diagram of the DT7837 Module

ARM Block

The ARM block of the DT7837 module uses the TI Sitara AM3352 processor and its associated peripherals to provide an open-source, single-board computer. The AM3352 supports many different interfaces, many of which are shared on the configurable I/O pins. In addition to the AM3352, the DT7837 module uses an embedded NAND flash and an FPGA.

This section describes the features of the ARM block in more detail.

ARM Processor

The AM3352 is based on the ARM Cortex-8 32-bit processor and is configured to run at 600 MHz.

Refer to the following web site for more information on this processor:
http://www.ti.com/product/am3352

Memory

A 512 MB, DDR3, SDRAM memory device is connected to the AM3352 processor through a dedicated DDR (Double Data Rate) memory interface.

Embedded NAND Flash

A 2 GB embedded NAND flash device is connected to the AM3352 processor through the 16-bit GPMC (General Purpose Memory Controller) bus, and can be accessed at the CS0 address space. The flash memory contains the Linux kernel, bootloader, and the file system.

You can also use the flash memory for general-purpose data and file storage as well as for input data and waveform storage.

EEPROM

An 8 kByte EEPROM device is connected to the I2C0, 2-wire, serial interface of the AM3352 processor. The EEPROM stores information about the device, including the calibration information.

Micro SD Card

A micro SD card slot is provided to support optional high-speed (up to 24 MB/s) micro SD cards. Micro SD cards (not provided with the module) communicate with the AM3352 processor using the MMC0 port in the 4-bit interface mode.

You can use a micro SD card as a boot source or for general-purpose file and data storage.

USB Device (Client) Port

The DT7837 module provides a USB 2.0 device (client) port on a type B receptacle. The device port connects to the USB port 0 controller of the AM3352 processor.

When connected to a host computer through this USB port, the host computer can identify the DT7837 module and load the appropriate drivers through the enumeration process.

USB Host Port

The DT7837 provides a high-speed USB 2.0 host port on a type A receptacle. The host port connects to the USB port 1 controller of the AM3352 processor. The USB host port supports any USB device, provided that the required software is installed on the Linux operating system.

If desired, you can connect USB devices, such as a keyboard, mouse, memory stick, or hub to this port.

Serial Port 0

Serial port 0 is a 3.3 V TTL serial interface provided on a 6-pin header. This port supports transmit and receive signals (no handshaking), and connects to the UART 0 interface of the AM3552 processor.

This port is particularly useful when you are debugging your applications. To use this port, use the EP405 USB to serial TTL adapter cable.

Serial Port 1 / I^2C2 Port

Serial port 1 and the I^2C2 port are provided on the same 6-pin header.

Serial port 1 is a 3.3 V TTL serial interface that supports transmit and receive signals, and connects to the UART1 interface of the AM3552 processor.

The bidirectional I^2C2 port connects to the I^2C port 2 interface of the AM3552 processor and is provided for embedded connectivity. It is possible to reconfigure the pins of the I^2C port 2 interface as the remaining UART 1 pins to provide the full functionality of serial port 1.

SPI Port

The SPI (Serial Peripheral Interface) is provided on an additional 6-pin header for embedded connectivity. This port connects to the SPI port 1 interface of the AM3552 processor.

GPMC Bus Interface

A 16-bit address/data multiplexed bus interface is supplied by the processor. In addition to the NAND flash, this bus also supports the FPGA. All control registers for the DT7837 are accessible in the CS1 address space. The CS3 address space provides access to the input FIFO.

Additional Signals Used on Processor

The following are additional pins on the processor that are connected for use on the DT7837 module:

- XDMAEvent0 – Configured, but not used
- XDMAEvent1 – Used for an analog output DMA event (currently not supported)
- XDMAEvent2 – Used for an analog input DMA event
- GPIO1_20 – Configured for a DMA event, but not used
- GPIO1_25 – Configured as an interrupt, but not used
- GPIO1_26 – Configured as an interrupt, but not used
- GPIO1_27 – Configured as an interrupt, but not used
- GPIO3_20 – Configured as an interrupt, but not used

Digital Connector

The Digital connector provides access to the tachometer input and GPIO (General Purpose Input and Output) signals of the DT7837 module. Refer to page 77 for the pin assignments of this connector.

Using software, you can specify a general-purpose input signal as the signal source for the following destinations:

- Digital input (the default signal for each general-purpose input pin)
- External A/D trigger input
- External D/A trigger input
- Gate input for the general-purpose counter/timer (C/T 0)
- Clock input for the general-purpose counter/timer (C/T 0)

Using software, you can specify a general-purpose (general-purpose) output signal as the signal source for one of these destinations:

- Digital output (the default signal for each general-purpose output pin)
- Clock output for the general-purpose counter/timer (C/T 0)

Note that a single general-purpose input may drive several destinations at the same time. However, a single general-purpose output can have only one driving source.

Analog Input Features

This section describes the following features of analog input (A/D) subsystem on the DT7837 module:

- Analog input channels, described on this page
- Input ranges and gains, described on this page
- IEPE functions, described on page 30
- Input resolution, described on page 30
- Continuous sampling mode, described on page 30
- Input triggers, described on page 31
- Input sample clock source and sampling frequency, described on page 32
- Data format and transfer, described on page 33
- Error conditions, described on page 33

Analog Input Channels

The DT7837 module provides four analog input channels (channels 0 to 3). These are single-ended channels; you can connect IEPE sensors to these inputs, if desired; refer to page 30 for more information on IEPE functions.

Note: To maintain simultaneous operation, all analog input connections on the DT7837 module must have the same lead lengths.

The DT7837 module uses four, Delta-Sigma, 24-bit ADCs that provide anti-aliasing filters based on the clock rate. These filters remove *aliasing*, which is a condition where high frequency input components erroneously appear as lower frequencies after sampling.

Using software, you can specify which analog input channels to sample by specifying bits 0 to 3 in the channel mask for the input stream.

Input Ranges and Gains

The DT7837 module provides an input range of ±10 V and software-selectable gains of 1 and 10. This provides effective input ranges of ±10 V (when the gain is 1) and ±1 V (when the gain is 10).

IEPE Functions

Applications that require accelerometer, vibration, noise, or sonar measurements often use IEPE sensors. IEPE conditioning is built-in to the analog input circuitry of the DT7837 module. The modules support the following software-programmable IEPE functions for each analog input channel:

- Excitation current source – The DT7837 module provides an internal excitation current source of 4 mA. You can turn the internal excitation current source on or off using software.
- Coupling type – You can select whether AC coupling or DC coupling is used.

DT7837 modules provide +20 V compliance voltage.

Note: If you enable the use of the internal excitation current source, it is recommended that you choose AC coupling.

Input Resolution

The resolution of the analog input channels is fixed at 24 bits; you cannot specify the resolution in software.

Continuous Sampling Mode

The DT7837 module supports continuous sampling mode on the input stream. This is an asynchronous I/O operation that is non-blocking so that your application can perform other operations while acquisition is being performed.

In continuous sampling mode, you can acquire data from the following channels in the input data stream: analog input channels 0 to 3, the tachometer input, the general-purpose counter/timer, the measure counter, and the digital input port. In software, you specify the channel mask for the input stream to determine which channels to sample. The bits of the channel mask are as follows:

- Channels (bits) 0 to 3 – Analog input channels 0 to 3
- Channel (bit) 4 – Tachometer; refer to page 34 for more information
- Channel (bit) 5 – Counter/timer 0; refer to page 36 for more information
- Channel (bit) 6 – Measure counter; refer to page 43 for more information
- Channel (bit) 7 – Digital input port; refer to page 47 for more information

The trigger that starts acquisition for the channels in the input stream can be any of the supported start trigger sources. Refer to page 31 for more information about the start trigger sources. However, the input stream of the module must be armed (using software) before the module can detect the trigger condition.

If a software trigger is specified as the start trigger, acquisition starts immediately when the software start command is executed. Otherwise, acquisition begins when the specified trigger signal is detected. When it detects the specified start trigger, the module simultaneously acquires data from all of the channels in specified in the input stream. Acquisition repeats continuously until you stop the operation. The conversion rate is determined by the sampling frequency; refer to page 32 for more information.

When you stop the operation using software, the DMA engine stops and no further data is collected. It is the programmer's responsibility to clean up all inprocess control block resources. To restart the operation, the input stream of the module must be armed and started again.

Figure 8 illustrates continuous acquisition mode using three channels: analog input channels 0 and 1 and the digital input port. When the start trigger is detected, samples from the specified channels are acquired continuously.

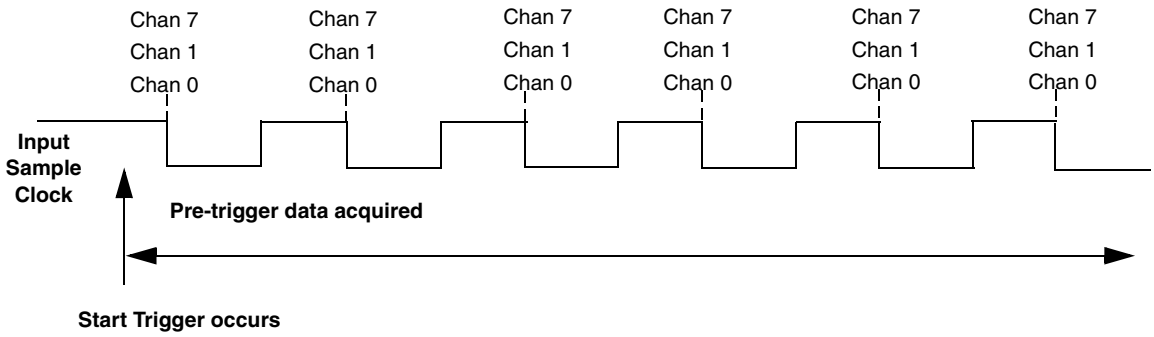

Figure 8: Continuous Sampling Mode on the DT7837 Module

Input Triggers

A trigger is an event that occurs based on a specified set of conditions. For continuous sampling mode of the channels in the input data stream, described on page 30, you must specify a start trigger to start acquisition.

The DT7837 module supports the following sources for the start trigger; you configure the trigger source and its parameters using software:

- **Software trigger** – A software trigger event occurs when you start the analog input operation (the computer issues a write to the module to begin conversions). Using software, specify the start trigger source as a software trigger.
- **External digital (TTL) trigger** – An external digital (TTL) trigger event occurs when the module detects a rising- or falling-edge transition on the signal connected to a general-purpose input pin on the Digital connector. (Refer to page 27 for more the pin descriptions of the Digital connector.) You can specify which edge is active using software.

- **Threshold trigger** – The start trigger event occurs when the signal attached to a specified analog input channel rises above or falls below a user-specified threshold value. Using software, you specify the following parameters:
  - Edge – Specify a rising-edge threshold trigger if you want to trigger when the signal rises above a threshold level, or a falling-edge threshold trigger if you want to trigger when the signal falls below a threshold level.
  - Threshold channel – Specify any one of the analog input channels as the threshold input channel.
  - Threshold level – Specify a value between ±10 V for a gain of 1 or ±1 V for a gain of 10 as the threshold level. Note that in software, this value must be entered as counts.

    To convert raw counts to volts, use the following formulas:

    Gain of 1: *volts* = ((2.0f * 10.0f * *counts*)/(1<<24) – 10.0f)

    Gain of 10: *volts* = ((2.0f * *counts*)/(1<<24) – 1.0f)

Note: The DT7837 driver sets the threshold level as close as possible to the value that you specify. However, the value that you specify may not be the actual value that is set. You can return the actual threshold level that was set using software.

Input Clock Source and Sampling Frequency

The DT7837 module supports an internal A/D clock, which is derived from the 48 MHz reference clock. The reference clock is generated from the onboard oscillator.

Using software, you specify the frequency at which to pace input operations. The sampling frequency can range from 195.3125 Hz to 105.469 kHz.

Note: According to sampling theory (Nyquist Theorem), specify a frequency that is at least twice as fast as the input's highest frequency component. For example, to accurately sample a 20 kHz signal, specify a sampling frequency of at least 40 kHz to avoid aliasing.

The DT7837 driver sets the sampling frequency as close as possible to the value that you specify. However, the value that you specify may not be the actual value that is set. You can return the actual sampling frequency that was set using software.

Once the sample clock is started, the module requires 39 conversions before the first A/D sample is valid. The valid sample is aligned with the start trigger.

Note: After changing the A/D master clock, wait a few milliseconds for the master clock to settle before calibrating the module or performing an acquisition.

The DT7837 module has two power modes: low power mode and high power mode. Low power mode is used when you specify a sampling frequency less than 52.734 kHz. High power mode is used when you specify a sampling frequency greater than or equal to 52.734 kHz. If you change the power mode from low to high power or from high power to low power, and then configure the device, the module is self-calibrated. You may notice that it takes time after the device is configured to complete the calibration process.

Data Format and Transfer

The DT7837 has an input FIFO of 2 kSamples (8 kBytes). Each sample of the DT7837 is a 32-bit value.

The DT7837 module uses offset binary data encoding, where 000000 represents negative full-scale, and FFFFFFh represents positive full-scale. Use software to specify the data encoding as binary. The ADC outputs FFFFFFh for above-range signals, and 000000 for below-range signals.

Error Conditions

The DT7837 module will detect an overrun error if the user buffers are not being sent to the module fast enough, and the A/D converters run out of user buffers to fill. To avoid this error, try one or more of the following:

- Reduce the clock rate of the A/D
- Increase the size of the buffers
- Increase the number of buffers
- Close any other applications that are running

Tachometer Input Features

You can connect a tachometer signal with a range of ±30 V to pin 23 of the Digital connector. (Refer to page 27 for the pin descriptions of the Digital connector.) The tachometer input accepts signals with a maximum frequency of 1 MHz and a minimum pulse width of 0.4 µs. The threshold voltage is fixed at +2 V with 0.5 V of hysteresis.

To read the value of tachometer in the input stream, specify bit 4 in the channel mask for the input stream.

You can measure the frequency or period of the tachometer input signal to calculate the rotation speed for high-level (±30 V) tachometer input signals. An internal 12 MHz counter is used for the measurement, yielding a resolution of 83 ns (1/12 MHz).

You can read the number of counts between two consecutive starting edges of the tachometer input signal by including channel 4 for the DT7837 in the analog input channel list. The starting edge is programmable (either rising or falling).

Using software, you can also specify a flag (called Stale) that indicates whether or not the data is new. If the Stale flag is set as Used (the default value), the most significant bit (MSB) of the value is set to 0 to indicate new data; reading the value before the measurement is complete returns an MSB of 1. If the Stale flag is set to Not Used, the MSB is always set to 0.

When the input operation is started, the internal 12 MHz counter starts incrementing when it detects the first starting edge of the tachometer input and stops incrementing when it detects the next starting edge; at that point, the counter stores the count. The stored count is maintained until it is read as part of the input data stream or until a new count is stored. The next tachometer measurement operation is started automatically.

If the sample rate of the input subsystem is faster than the tachometer input frequency, then the stored count retains the current value when the count is read by the input subsystem. The operation of the Stale flag in this case is described as follows:

- If another input subsystem sample occurs before another measure completes and the Stale flag is enabled, then the Stale flag is set and the stale measure count is written into the input data stream.
- If another input subsystem sample occurs before another measure completes and the Stale flag is disabled, then the Stale flag is not set and the stale measure count is written into the input data stream.

If the input sample rate is slower than the tachometer input frequency, then as each period measurement completes, a new count value is stored. When the input subsystem sample occurs, the most recently stored measure count is written into the input data stream.

A data pipeline is used in the hardware to compensate for the A/D group delay and synchronizes the value of the tachometer input with the analog input measurements so that all measurements are correlated in time. The tachometer input is treated like any other channel in the analog input channel list; therefore, all the triggering and conversion modes supported for analog input channels are supported for the tachometer input.

When you read the value of the tachometer input as part of the analog input data stream, you might see results similar to the following:

Table 1: An Example of Reading the Tachometer Input as Part of the Analog Input Data Stream

Time	A/D Value	Tachometer Input Value	Status of Operation
10	5002	0	Operation started, but is not complete
20	5004	0	Operation not complete
30	5003	0	Operation not complete
40	5002	12373	Operation complete
50	5000	12373	Next operation started, but is not complete
60	5002	12373	Operation not complete
70	5004	12373	Operation not complete
80	5003	14503	Operation complete
90	5002	14503	Next operation started, but is not complete

Using the count that is returned from the tachometer input, you can determine the following:

- Frequency of a signal pulse (the number of periods per second). You can calculate the frequency as follows:
  - Frequency = 12 MHz/(Number of counts – 1)
    where 12 MHz is the internal counter/timer clock frequency

    For example, if the count is 21, the measured frequency is 600 kHz (12 MHz/20).
- Period of a signal pulse. You can calculate the period as follows:
  - Period = 1/Frequency
  - Period = (Number of counts – 1)/12 MHz
    where 12 MHz is the internal counter/timer clock frequency

General-Purpose Counter/Timer Features

This section describes the following features of counter/timer (C/T) operations:

- C/T channels, described below
- C/T clock sources, described on page 37
- Gate types, described on page 37
- Pulse output period and duty cycle, described on page 38
- C/T operation modes, described on page 39

C/T Channels

DT7837 modules provide one 32-bit, general-purpose counter/timer (C/T 0). As shown in Figure 9, the counter/timer accepts a clock input and gate input signal and outputs a pulse (clock output signal).

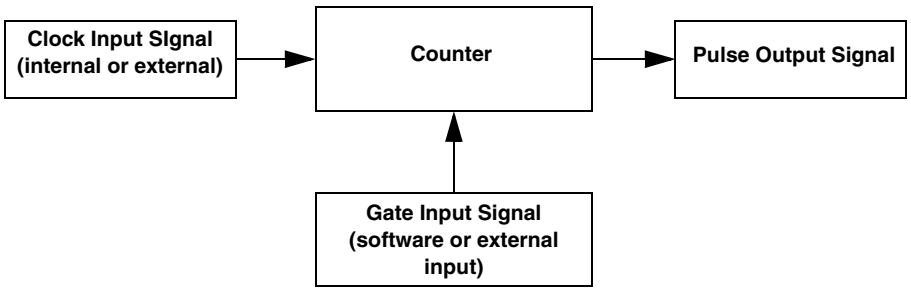

Figure 9: Counter/Timer Channel

Using software, you define general-purpose I/O pins on the Digital connector for the external C/T clock input, external C/T gate input, and C/T clock output signals.

To read the value of C/T 0 in the input stream, specify bit 5 in the channel mask of the input stream.

C/T Clock Input Sources

The following clock input sources are available for the general-purpose counter/timer; you select the clock source through software:

- **Internal C/T clock** – The internal C/T clock uses a 48 MHz time base. This clock source is typically used for one-shot, repetitive one-shot, and rate generation operations.
- **External C/T clock** – An external C/T clock is useful when you want to pace counter/timer operations at rates not available with the internal C/T clock or if you want to pace at uneven intervals. The frequency of the external C/T clock can range from 0.0112 Hz to 10 MHz.

  This clock source is typically used for event counting and rate generation operations.

  Using software, specify one of the general-purpose input pins (1 to 8) of the Digital connector on the DT7837 module as the external C/T clock input. Then, physically connect the external clock signal to the selected pin. (Refer to page 27 for the pin descriptions of the Digital connector.) Counter/timer operations start on the rising edge of the clock input signal.

Note: If you specify a counter/timer in the input stream, the A/D clock determines how often you want to read the counter value. Refer to page 32 for more information about the A/D sample clock.

Gate Types

The edge or level of the counter gate signal determines when a counter/timer operation is enabled.

Unless you are using a software gate (no gate), define one of the general-purpose input pins of the Digital connector on the DT7837 module as the external C/T gate input using software. Then, physically connect the external gate signal to the selected pin. (Refer to page 27 for the pin descriptions of the Digital connector.)

DT7837 modules provide the following gate types; you select the gate type using software:

- **None** – A software start command enables any counter/timer operation immediately after execution. (No general-purpose input signal is required if a gate type of None is selected.)
- **Low external gate input** – Specifies a logic low or falling edge gate type. For event counting and rate generation mode, the operation is enabled when the counter's gate signal is low and is disabled when the counter's gate signal is high. For one-shot mode or repetitive one-shot mode, the operation is enabled when the counter's gate signal goes from a high to a low transition and is disabled when the counter's gate signal goes from a low to a high transition.

  You specify one of the general-purpose input pins (1 to 8) of the Digital connector on the DT7837 module as the external C/T gate input. Ensure that you physically connect the external gate signal to the selected pin. (Refer to page 27 for the pin descriptions of the Digital connector.)

- **High external gate input** – Specifies a logic high or rising edge gate type. For event counting and rate generation mode, the operation is enabled when the counter's gate signal is high and is disabled when the counter's gate signal is low. For one-shot mode or repetitive one-shot mode, the operation is enabled when the counter's gate signal goes from a low to a high transition and is disabled when the counter's gate signal goes from a high to a low transition.

  You specify one of the general-purpose input pins (1 to 8) of the Digital connector on the DT7837 module as the external C/T gate input. Ensure that you physically connect the external gate signal to the selected pin. (Refer to page 27 for the pin descriptions of the Digital connector.)

Pulse Output Period, Pulse Width, and Polarity

If you want to perform a C/T output operation, define one of the general-purpose output pins (11 to 18) of the Digital connector on the DT7837 module as the external C/T output signal using software. Then, connect the external C/T output signal to the selected pin. (Refer to page 27 for the pin descriptions of the Digital connector.)

For the DT7837 module, you can program the polarity of the output pulse (active high or active low). For an active high pulse, the high portion of the total pulse output period is the active portion of the counter/timer pulse output signal. For an active low pulse, the low portion of the total pulse output period is the active portion of the counter/timer pulse output signal.

Using software, you can specify the number of input clock cycles that are used to create one period of the counter clock output signal. You can also specify the number of input clock cycles used to create the active pulse width (or duty cycle) of the C/T output signal.

For example, if you are using an external C/T clock running at 10000 Hz as the input clock source of the counter/timer, and you want to generate a output signal of 1000 Hz with a 20% duty cycle, specify a period of 10 (10000 Hz divided by 10 is 1000 Hz) and a pulse width of 2 (the period of 10 multiplied by 20%). This is illustrated in Figure 10.

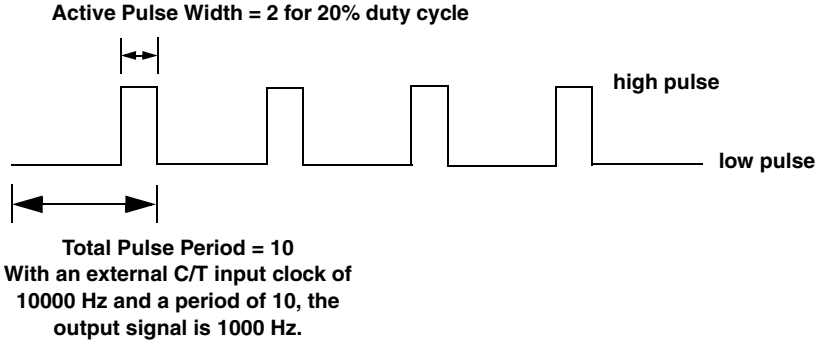
Active Pulse Width = 2 for 20% duty cycle
high pulse
low pulse
Total Pulse Period = 10
With an external C/T input clock of
10000 Hz and a period of 10, the
output signal is 1000 Hz.

Figure 10: Example of a Pulse Output

Note: If you are using an internal C/T clock input source, you can output pulses using a maximum frequency of 24 MHz. Note, however, that the integrity of the signal degrades at frequencies greater than 10 MHz.

If you are using an external C/T clock input source, you can output pulses using a maximum frequency of 5 MHz.

Counter/Timer Operation Modes

The general-purpose counter/timer on the DT7837 module supports the following counter/timer operation modes:

- Event counting
- Rate generation
- Non-repeatable one-shot
- Idle

The following subsections describe these modes in more detail.

Event Counting

Use event counting mode if you want to count the number of rising edges that occur on the counter's clock input when the counter's gate signal is active (low-level or high-level).

You can count a maximum of 4,294,967,296 events before the counter rolls over to 0 and starts counting again.

Using software, you must specify the following parameters for the event counting operation:

- Active gate type (external low level or external high level). Refer to page 37 for more information about the supported gate types.
- The general-purpose input pin to use for the external gate signal. Ensure that you physically connect the gate signal to this input pin. Refer to page 27 for the pin descriptions of the Digital connector.
- The C/T clock source (internal or external). Note that in event counting mode, the external C/T clock is more useful than an internal C/T clock; refer to page 37 for more information about the C/T clock sources.
- The general-purpose input pin to use for the external C/T clock input. Ensure that you physically connect the clock input signal to this input pin. Refer to page 27 for the pin descriptions of the Digital connector.

Refer to page 39 for an example of connecting an event counting application.

Rate Generation

Use rate generation mode to generate a continuous pulse output signal from the counter's output signal. You can use this pulse output signal as an external clock to pace other operations, such as an analog input or other counter/timer operations.

The pulse output operation is enabled whenever the counter's gate signal is at the specified level. While the pulse output operation is enabled, the counter outputs a pulse of the specified type and frequency continuously. As soon as the operation is disabled, rate generation stops.

You can output pulses using a maximum frequency of 24 MHz (if using the internal C/T clock) or 5 MHz (if using the external C/T clock).

Note: The integrity of the signal degrades at frequencies greater than 10 MHz.

Using software, you must specify the following parameters for the rate generation operation:

- Active gate type (external low level or external high level). Refer to page 37 for more information about the supported gate types.
- The general-purpose input pin to use for the external gate signal. Ensure that you physically connect the gate signal to this input pin. Refer to page 27 for the pin descriptions of the Digital connector.
- The C/T clock source (internal or external). Refer to page 37 for more information about the C/T clock sources.
- If you are using an external C/T clock source, the general-purpose input pin to use for the external C/T clock input. Ensure that you physically connect the clock input signal to this input pin. Refer to page 27 for the pin descriptions of the Digital connector.
- The period of the output pulse. Refer to page 38 for more information about the period of the output pulse.
- The pulse width (duty cycle) of the active pulse. Refer to page 38 for more information about the pulse width of the output pulse.
- The general-purpose output signal to use for the C/T clock output signal. Ensure that you physically connect the C/T output signal to this output pin. Refer to page 27 for the pin descriptions of the Digital connector.
- The polarity of the output signal (active high or active low). Refer to page 38 for more information on the polarity of the output pulse.

Refer to page 40 for an example of connecting a rate generation application.

Non-Repeatable One-Shot

Use non-repeatable one-shot mode to generate a single output pulse from the counter whenever the specified edge is detected on the counter's gate signal (after the pulse period from the previous output pulse expires). Any gate signals that occur while the pulse is being output are not detected by the module, as shown in Figure 11. The module continues to output a pulse when the specified gate edge is detected until you stop the operation. You can use this mode to clean up a poor clock input signal by changing its pulse width, and then outputting it.

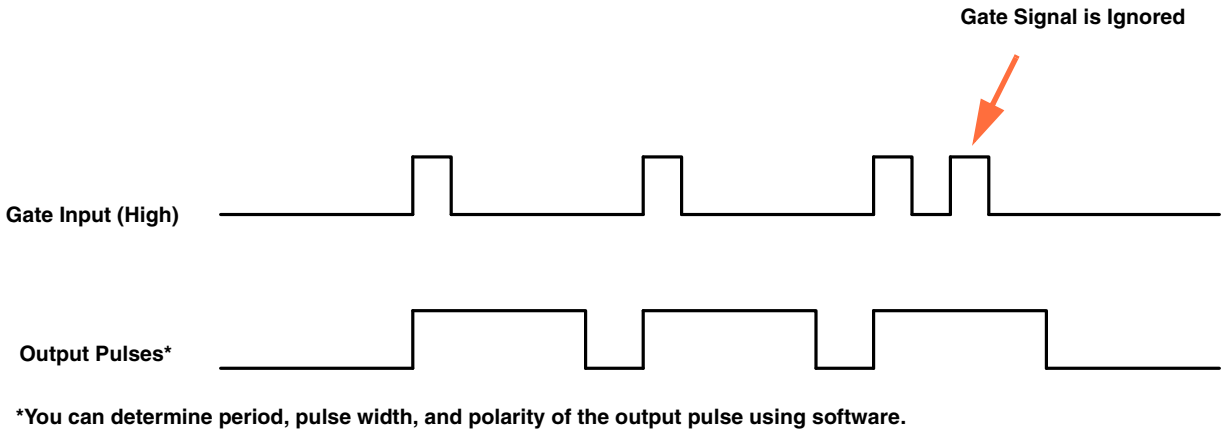
Gate Signal is Ignored
Gate Input (High)
Output Pulses*
*You can determine period, pulse width, and polarity of the output pulse using software.

Figure 11: Non-Repeatable One-Shot Mode

Using software, you must specify the following parameters for the non-repeatable one-shot operation:

- Active gate type that enables the operation. Refer to page 37 for more information about the supported gate types.
- The general-purpose input pin to use for the external gate signal. Ensure that you physically connect the gate signal to this input pin. Refer to page 27 for the pin descriptions of the Digital connector.
- The C/T clock source (internal or external) that generates the pulse. Note that in one-shot mode, the internal C/T clock is more useful than an external C/T clock; refer to page 37 for more information about the C/T clock sources.
- The general-purpose input pin to use for the external C/T clock input. Ensure that you physically connect the clock input signal to this input pin. Refer to page 27 for the pin descriptions of the Digital connector.
- The period of the output pulse. Refer to page 38 for more information about the period of the output pulse.
- The pulse width (duty cycle) of the active pulse. Refer to page 38 for more information about the pulse width of the output pulse.

- The general-purpose output signal to use for the C/T clock output signal. Ensure that you physically connect the C/T output signal to this output pin. Refer to page 27 for the pin descriptions of the Digital connector.
- The polarity of the output signal (active high or active low). Refer to page 38 for more information on the polarity of the output pulse.
- Retriggerable setting of 0 for non-repeatable one-shot.

Refer to page 41 for an example of connecting a non-repeatable one-shot application.

Idle Mode

If you use idle mode, the counter no longer drives the clock output signal that is assigned to one of the general-purpose output signals (pins 11 to 18) of the Digital connector.

Note: The value of the counter output signal can also be overwritten by writing to the digital output subsystem.

If you assigned a general-purpose input signal as a counter clock or gate input (or external trigger), you can read the value of the signal as you would any other digital input signal.

Refer to page 47 for more information on digital I/O operations.

Measure Counter Features

DT7837 modules provides one measure counter. Using this counter, you can measure the frequency, period, or pulse width of a single signal or the time period between two signals and return the value in the analog input stream. This is useful for correlating the analog input data with digital positional data, measuring the frequency of a signal, or as a tachometer. An internal 48 MHz counter is used for the measurement, yielding a resolution of 20 ns (1/48 MHz).

Using software commands, you can configure the following parameters for the measure counter:

- The signals that start and stop the measurement. Refer to Table 2 for the supported start and stop signals.

Table 2: Possible Start and Stop Signals

Signal	Connection Required
A/D conversion complete	No connection required.
Tachometer input (falling edge or rising edge)	Connect to Tachometer input.
Digital input 0 (falling edge or rising edge)	Connect a digital input, external A/D trigger, C/T clock input, or C/T gate input to general-purpose input 0 (pin 1) of the Digital connector. By default, this is digital input 0.
Digital input 1 (falling edge or rising edge)	Connect a digital input, external A/D trigger, C/T clock input, or C/T gate input to general-purpose input 1 (pin 2) of the Digital connector. By default, this is digital input 1.
Digital input 2 (falling edge or rising edge)	Connect a digital input, external A/D trigger, C/T clock input, or C/T gate input to general-purpose input 2 (pin 3) of the Digital connector. By default, this is digital input 2.
Digital input 3 (falling edge or rising edge)	Connect a digital input, external A/D trigger, C/T clock input, or C/T gate input to general-purpose input 3 (pin 4) of the Digital connector. By default, this is digital input 3.
Digital input 4 (falling edge or rising edge)	Connect a digital input, external A/D trigger, C/T clock input, or C/T gate input to general-purpose input 4 (pin 5) of the Digital connector. By default, this is digital input 4.
Digital input 5 (falling edge or rising edge)	Connect a digital input, external A/D trigger, C/T clock input, or C/T gate input to general-purpose input 5 (pin 6) of the Digital connector. By default, this is digital input 5.
Digital input 6 (falling edge or rising edge)	Connect a digital input, external A/D trigger, C/T clock input, or C/T gate input to general-purpose input 6 (pin 7) of the Digital connector. By default, this is digital input 6.
Digital input 7 (falling edge or rising edge)	Connect a digital input, external A/D trigger, C/T clock input, or C/T gate input to general-purpose input 7 (pin 8) of the Digital connector. By default, this is digital input 7.

- A flag (called Stale) indicating whether or not the data is new. This flag is used only when the start edge and the stop edge is set to use the same pin and edge.

  If the Stale flag is set as Used (the default value), the most significant bit (MSB) of the value is set to 0 to indicate new data; reading the value before the measurement is complete returns an MSB of 1. If the Stale flag is set to Not Used, the MSB is always set to 0.

When the selected start edge is the same as the selected stop edge, the internal 48 MHz counter starts incrementing when it detects the first start edge of the selected input signal and stops incrementing when it detects the selected stop edge (which is the same as the start edge, in this case); at that point, the counter stores and resets the count. The stored count is maintained until it is read as part of the input data stream or until a new count is stored. Since the stop edge is the same as the start edge in this case, the stop edge for the current measurement is the start edge for the next measurement; therefore, no waveform periods are missed. The value of the measure count depends on the input subsystem sample frequency, described as follows:

- If the input subsystem sample frequency is faster than the selected input frequency, then the stored measure count retains the current value when it is read by the input subsystem. The operation of the Stale flag in this case is described as follows:
  - If another input subsystem sample occurs before another measure completes and the Stale flag is used, then the Stale flag is set and the stale measure count is written into the input data stream.
  - If another input subsystem sample occurs before another measure completes and the Stale flag is not used, then the Stale flag is not set and the stale measure count is written into the input data stream.
- If the input subsystem sample frequency is slower than the selected input frequency, then the new measure count value is stored as each period measurement completes. When an input subsystem sample occurs, then the most recently stored measure count is written into the input data stream.

When the selected start edge is not the same as the selected stop edge, the internal 48 MHz counter starts incrementing when it detects the selected start edge and stops incrementing when it detects the next selected stop edge; at that point, the counter stores and resets the count. The stored count is maintained until it is read as part of the input data stream or until a new count is stored. The value of the measure count depends on the input subsystem sample frequency, described as follows:

- If the input subsystem sample rate is faster than the selected measurement period, then the stored count retains the current value when the count is read by the input subsystem. The operation of the Stale flag in this case is described as follows:
  - If another input subsystem sample occurs before another measure completes and the Stale flag is used, then the Stale flag is set and the stale measure count is written into the input data stream.
  - If another input subsystem sample occurs before another measure completes and the Stale flag is not used, then the Stale flag is not set and the stale measure count is written into the input data stream.

- If the input subsystem sample rate is slower than the selected measurement period, then a new count value is stored as each period measurement completes. When an input subsystem sample occurs, the most recently stored measure count is written into the input data stream.

A data pipeline is used in the hardware to compensate for the A/D group delay and synchronizes the value of the measure counter with the analog input measurements, so that all measurements are correlated in time. The measure counter is treated like any other channel in the analog input channel list; therefore, all the triggering and conversion modes supported for analog input channels are supported for the measure counter.

When you read the value of the measure counter as part of the analog input data stream, you might see results similar to the following:

Table 3: An Example of Reading a Measure Counter as Part of the Analog Input Data Stream

Time	A/D Value	Measure Counter Values	Status of Operation
10	5002	0	Operation started, but is not complete
20	5004	0	Operation not complete
30	5003	0	Operation not complete
40	5002	12373	Operation complete
50	5000	12373	Next operation started, but is not complete
60	5002	12373	Operation not complete
70	5004	12373	Operation not complete
80	5003	14503	Operation complete
90	5002	14503	Next operation started, but is not complete

Using the count that is returned from the measure counter, you can determine the following:

- Frequency between the start and stop signals/edges. You can calculate the frequency as follows:
  - Frequency = 48 MHz/(Number of counts – 1)
    where 48 MHz is the internal measure counter frequency

    For example, if the count is 201, the measured frequency is 240 kHz (48 MHz/200).
- Period between the start and stop signals/edges. You can calculate the period as follows:
  - Period = 1/Frequency
  - Period = (Number of counts – 1)/48 MHz
    where 48 MHz is the internal measure counter frequency

- Pulse width of the start and stop signal/edges (rising to falling edge or falling edge to rising edge). You can calculate the period as follows:
  - Pulse width = 1/Frequency
  - Pulse width = (Number of counts – 1)/48 MHz
    where 48 MHz is the internal measure counter frequency

Digital I/O Features

This section describes the following features of digital I/O operations:

- Digital I/O lines
- Operation modes

Digital I/O Lines

DT7837 modules support one digital input port, consisting of up to 8 digital input lines (lines 0 to 7) and one digital output port, consisting of up to 8 digital output lines (lines 0 to 7). The resolution is fixed at 8 bits.

By default, general-purpose input pins 1 to 8 of the Digital connector on the DT7837 module correspond to digital input signals 0 to 7. Similarly, general-purpose output pins 11 to 18 of the Digital connector on the DT7837 module correspond to digital output signals 0 to 7.

Note: If you assigned a general-purpose input signal as a counter clock or gate input or as an external trigger, you can read the value of the signal as you would any other digital input signal, if desired.

If you want to write a value to a specific digital output line, ensure that the corresponding pin of the Digital connector is not configured for another use (such as the output of the counter/timer) or you could corrupt the signal on the pin.

A digital line is high if its value is 1; a digital line is low if its value is 0. On power up or reset, a low value (0) is output from each of the digital output lines and a high value (1) is read from each of the digital input lines if the lines are not connected.

Operation Modes

DT7837 modules support the following digital I/O operation modes:

- **Synchronous read and write operations** – Using software, you can read the value of the digital input port using a synchronous read operation or write a value to the digital output port using a synchronous write operation. The operation is blocking, in that it does not return until the value is read or written.

  You do not specify a trigger or clock for a synchronous read or write operation. The operation stops automatically once the value is read or written.

- **Continuous digital input** – Using software, enter the digital input port (all 8 digital input lines) as specify bit 7 of the channel mask in the input stream. You can specify the sampling frequency and trigger source for the input stream. The trigger starts the acquisition. The input sample clock paces the acquisition of data from the digital input port as well as the analog input channels, tachometer input, general-purpose counter/timer, and/or the measure counter.

Triggering Acquisition on Multiple Modules

The internal clock on the DT7837 module is derived from the 48 MHz crystal oscillator and provides the timing for the analog input subsystem on the module.

You can start acquisition on multiple modules by connecting all modules to a shared external trigger input, as shown in Figure 12. Using software, you must define one of the general-purpose input pins on the Digital connector on each DT7837 module as the external trigger signal. When triggered, the modules start acquiring data at the same time.

Using this connection scheme, the measurements of one module are not synchronous with the measurements of another module as they do not share the same reference clock.

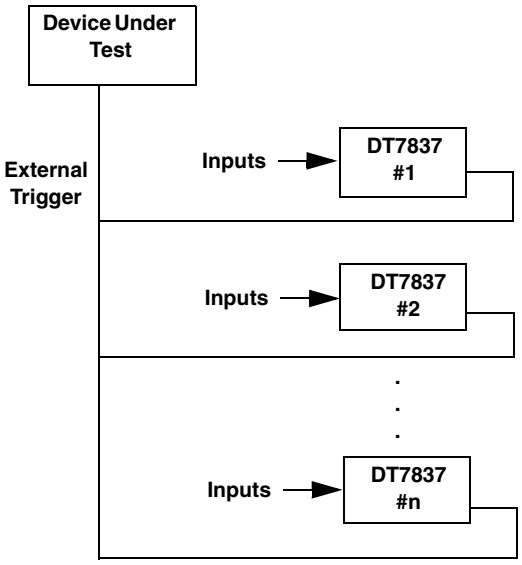

Figure 12: Triggering Multiple Modules Using an External Trigger Source

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Technical Support

Should you experience problems using the DT7837 module, follow these steps:

1. Read all the appropriate sections of this manual and the *DT7837 File I/O Programming Manual*.
2. Refer to the supplied example programs for clarification.
3. Check that you have installed your hardware devices properly.
4. Check that you have installed the software properly.

If you are still having difficulty using the DT7837 module, Data Translation's Technical Support Department is available to provide technical assistance.

To request technical support, go to our web site at http://www.datatranslation.com and click on the Support link.

When requesting technical support, be prepared to provide the following information:

- Your product serial number
- The hardware/software product you need help on

If you are located outside the USA, contact your local distributor; see our web site (www.datatranslation.com) for the name and telephone number of your nearest distributor.

If Your Module Needs Factory Service

If your module must be returned to Data Translation, do the following:

1. Record the module's serial number, and then contact the Customer Service Department at (508) 481-3700, ext. 1323 (if you are in the USA) and obtain a Return Material Authorization (RMA).

   If you are located outside the USA, call your local distributor for authorization and shipping instructions; see our web site (www.datatranslation.com) for the name and telephone number of your nearest distributor. All return shipments to Data Translation must be marked with the correct RMA number to ensure proper processing.

2. Using the original packing materials, if available, package the module as follows:

   – Wrap the module in an electrically conductive plastic material. Handle with ground protection. A static discharge can destroy components on the module.

   – Place in a secure shipping container.

3. Return the module to the following address, making sure the RMA number is visible on the outside of the box.

   Customer Service Dept.
   Data Translation, Inc.
   100 Locke Drive
   Marlboro, MA 01752-1192

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Calibrating the Analog Input Subsystem 56

Overview

DT7837 modules are calibrated at the factory and should not require calibration for initial use. We recommend that you check and, if necessary, readjust the calibration of the analog circuitry every six months using the DT7837 Calibration Utility.

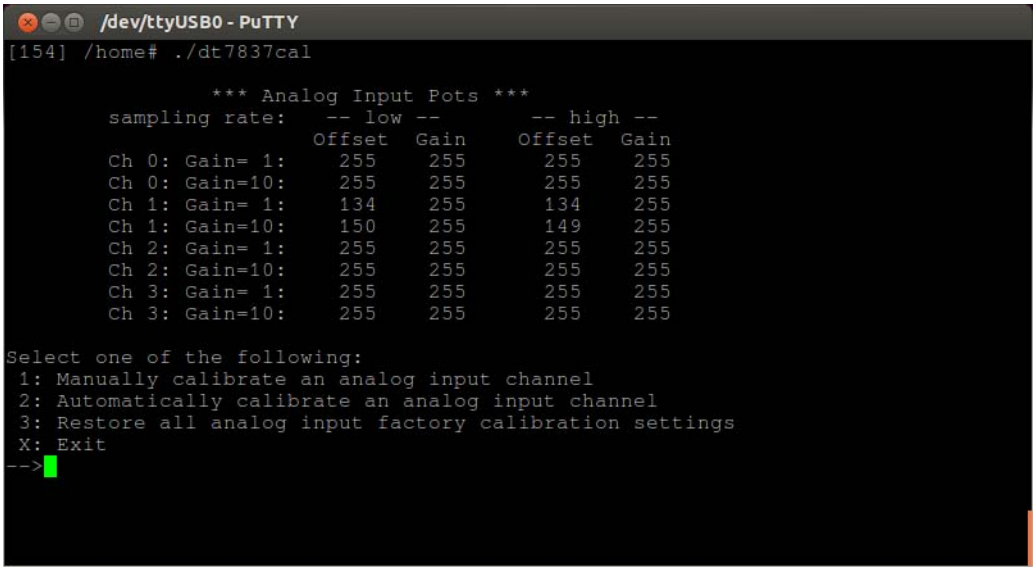
The DT7837 Calibration Utility is provided as both a web application (**cal-server)** and a command-line program (**dt7837cal**).

This chapter describes how to calibrate the analog input subsystem of a DT7837 module using the command-line program, **dt7837cal**.

Using the Calibration Utility

To use the command-line DT7837 Calibration Utility, perform the following steps:

1. From the **usr/local/dt7837/dt7837-calibration** directory on the module, type **dt7837cal**, and press Enter.
   The main screen of the DT7837 Calibration Utility appears.


/dev/ttyUSB0 - PuTTY
[154] /home# ./dt7837cal
*** Analog Input Pots ***
sampling rate: -- low -- -- high --
Offset Gain Offset Gain
Ch 0: Gain= 1: 255 255 255 255
Ch 0: Gain=10: 255 255 255 255
Ch 1: Gain= 1: 134 255 134 255
Ch 1: Gain=10: 150 255 149 255
Ch 2: Gain= 1: 255 255 255 255
Ch 2: Gain=10: 255 255 255 255
Ch 3: Gain= 1: 255 255 255 255
Ch 3: Gain=10: 255 255 255 255
Select one of the following:
1: Manually calibrate an analog input channel
2: Automatically calibrate an analog input channel
3: Restore all analog input factory calibration settings
X: Exit
-->

2. Once the calibration utility is running, calibrate the analog input circuitry either automatically or manually, as described on page 56.

Calibrating the Analog Input Subsystem

This section describes how to use the DT7837 Calibration Utility to calibrate each analog input channel of the DT7837 module.

Warming up the Module

Before calibrating the analog input circuitry, ensure that the module has been powered on for at least one hour.

Connecting a Precision Voltage Source

To calibrate the analog input circuitry, you need to connect an external precision voltage source to the DT7837 module that is capable of generating 0.0000 V to +9.3750 V. Connect the precision voltage source to the first analog input channel that you want to calibrate (typically analog input channel 0).

Using the Auto-Calibration Procedure

Auto-calibration is the easiest to use and is the recommended calibration method. To auto-calibrate the analog input subsystem, do the following:

1. From the main menu of the program, select **2: Automatically calibrate an analog input channel**.
2. Enter the number (0 to 3) of the analog input channel that you want to calibrate, then enter **Y** to continue.
3. Verify that 0.0000 V is applied to the channel that you want to calibrate.
4. Adjust the value to 0.0000 V by typing a value between **0** and **255** or by pressing the **+** or **–** key.
5. Verify that +9.3750 V is applied to the channel that you want to calibrate.
6. Adjust the value to +9.3750 V by typing a value between **0** and **255** or by pressing the **+** or **–** key.
7. Verify that +0.9375 V is applied to the channel that you want to calibrate.
8. Adjust the value to +0.9375 V by typing a value between **0** and **255** or by pressing the **+** or **–** key.
9. Repeat steps 2 through 8 for the remaining analog input channels on the module.
10. When you have finished calibrating the module, press **X** from the main menu to exit from the program.

Using the Manual Calibration Procedure

The DT7837 has two gains (1 and 10) and two power modes: low power mode and high power mode. Low power mode is calibrated when you specify a sampling frequency less than 52.734 kHz. High power mode is calibrated when you specify a sampling frequency greater than 52.734 kHz. Ensure that you calibrate each analog input channel for gains of 1 and 10 if you are using both gains and for both high and low power mode if you are using sampling frequencies below and above 52.734 kHz. By default, this utility uses DC coupling with the current source disabled.

To manually calibrate the analog input circuitry, do the following for each channel:

1. From the main menu of the program, select **1: Manually calibrate an analog input channel**.
2. Enter the number (**0** to **3**) of the analog input channel that you want to calibrate.
3. Enter the gain value (**1** or **10**) to calibrate for the analog input channel.
4. Enter **0** to calibrate the offset potentiometer or **1** to calibrate the gain potentiometer.
5. Enter **0** to calibrate the selected potentiometer for sampling frequencies less than or equal to 52734 Hz or **1** to calibrate the selected potentiometer for sampling frequencies greater than 52734 Hz.
   The current calibrations selections are displayed.
6. If the current selections are correct, enter **Y**. To fix an entry, enter **N** to repeat these steps.
7. If you chose to calibrate the offset potentiometer in step 4, adjust the potentiometer as follows:
   a. Verify that 0.0000 V is applied to the channel that you want to calibrate.
   b. Adjust the value to 0.0000 V by typing a value between **0** and **255** or by pressing the **+** or **–** key.
   c. Press **Enter** to display the current information for the channel, including the value of the potentiometer and the current reading.
   d. Repeat steps 7b and 7c until the reading is calibrated to 0.0000 V.
   e. Once calibrated, press **x** to exit to the main menu.
8. If you chose to calibrate the gain potentiometer in step 4 and selected a gain of 1 in step 3, adjust the potentiometer as follows:
   a. Verify that +9.375 V is applied to the channel that you want to calibrate.
   b. Adjust the value to +9.375 V by typing a value between **0** and **255** or by pressing the **+** or **–** key.
   c. Press **Enter** to display the current information for the channel, including the value of the potentiometer and the current reading.
   d. Repeat steps 8b and 8c until the reading is calibrated to +9.375 V.
   e. Press **x** to exit to the main menu.

9. If you chose to calibrate the gain potentiometer in step 4 and selected a gain of 10 in step 3, adjust the potentiometer as follows:
   a. Verify that +0.9375 V is applied to the channel that you want to calibrate.
   b. Adjust the value to +0.9375 V by typing a value between **0** and **255** or by pressing the **+** or **–** key.
   c. Press **Enter** to display the current information for the channel, including the value of the potentiometer and the current reading.
   d. Repeat steps 9b and 9c until the reading is calibrated to +0.9375 V.
   e. Press **x** to exit to the main menu.
10. Repeat these steps for each gain and sampling frequency for the selected channel.
11. Repeat these steps for each analog input channel.
12. When you have finished calibrating the module, press **X** from the main menu to exit from the program.

Restoring Factory-Calibration Settings

If you wish, you can restore the analog input calibration values for each channel to their original factory settings by selecting **3: Restore all analog input factory calibration settings** from the main menu of the DT7837 Calibration Utility.

A prompt is displayed to inform that the values were reset.

Specifications

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Analog Input Specifications

Table 4 lists the specifications for the analog input subsystem on the DT7837 module.

Table 4: Analog Input Subsystem Specifications

Feature	DT7837 Specifications
Number of analog input channels	4, single-ended
Resolution	24 bits
Ranges and gains Gain of 1: Gain of 10:	 ±10 V ±1 V
A/D type	Delta Sigma
Data encoding	Offset binary
Input FIFO	2 kSamples/s
Maximum sample rate	105.469 kS/s
Minimum sample rate	195.3125 S/s
ADC master clock range Sampling frequency < 52.734 kHz: 52.734 kHz to 105.469 kHz:	100 kHz to 27 MHz 512 x sample frequency 256 x sample frequency
Group delay	39/sample rate, in seconds
ADC Delta Sigma filter[a] Passband, –3 dB: Passband ripple, ±0.005 dB: Stopband, –100 dB:	 0.49 x sample frequency, Hz 0.453 x sample frequency, Hz 0.547 x sample frequency, Hz
Analog filter[a] Low pass cutoff, –3 dB: High pass cutoff, –3 dB (AC coupling):	 400 kHz 0.1 Hz
Channel-to-channel crosstalk[b] Input Signal = 1 kHz:	 ≤ –121 dB with 50 Ω termination
Input impedance	1 MΩ ‖ 20 pF[c]
Coupling	AC/DC (software-selectable per channel)
IEPE current source	4 mA ±0.5%
IEPE compliance voltage	24 V
IEPE current source noise DC to 1 kHz	 5 nARMS

Table 4: Analog Input Subsystem Specifications (cont.)

Feature	DT7837 Specifications	
DC Accuracy		
Offset error[d]	±1 mV	
Offset error temperature coefficient	±(7.2 µV/° C)/ Gain) ± 100 µV/° C	
Gain error Gain of 1: Gain of 10:	 ±0.02% ±0.5%	
Gain error temperature coefficient	50 ppm/° C	
ADC Integral Non-Linearity error, INL	±0.0006% of full-scale range	
ADC Differential Non-Linearity error, DNL	Monotonic to 24 bits	
Dynamic Performance[e]	**Gain of 1**	**Gain of 10**
Effective Number of Bits, ENOB[f] (1 kHz input, 105.5 kSPS) –1 dBFS input: –6 dBFS input:	 15 bits 16 bits	 15 bits 16 bits
Signal to Noise and Distortion Ratio, SINAD[g] (1 kHz input, 105.5 kSPS) –1 dBFS input: –6 dBFS input:	 93 dB 92 dB	 93 dB 92 dB
Signal to Noise Ratio, SNR[h] (1 kHz input, 105.5 kSPS) –1 dBFS input: –6 dBFS input:	 97 dB 96 dB	 97 dB 96 dB
Total Harmonic Distortion, THD[i] (1 kHz input, 105.5 kSPS) –1 dBFS input: –6 dBFS input:	 –102 dB –100 dB	 –102 dB –101 dB
Spurious Free Dynamic Range, SFDR[j] (1 kHz input, 105.5 kSPS) –1 dBFS input: –6 dBFS input:	 97 dBFS 103 dBFS	 98 dBFS 102 dBFS
Noise Floor (50 Ω input termination, 105.5 kSPS)	56 µVRMS	65 µVRMS
Overvoltage Protection		
Overvoltage protection Power on: Power off:	 +40 V to –20 V ±40 V	
ESD protection Arc: Contact:	 8 kV 4 kV	

a. The total frequency response is the combined frequency response of the ADC Delta Sigma filter and the analog filter.
b. Channel 0 is the reference channel with a 20 Vpp signal and a maximum sample rate of 105.469 kSamples/s.
c. Cable capacitance of 30 pF per foot (typical) must be added.
d. Offset errors are referred to the input.

e. ENOB, SINAD, SNR, THD, and SFDR measurements were made with a 16384 point FFT with a minimum 4-term Blackman Harris window.
f. Effective Number of Bits (ENOB) is calculated from the SINAD value with adjustment for level below full-scale of the input signal.

$$ENOB = \frac{(SINAD - 1.76 + IBFS)}{6.02}$$

where, IBFS is a positive value in dB, representing the ratio of a full-scale signal to the input signal.

g. Signal to Noise and Distortion (SINAD) is the ratio of the RMS value of the input signal to the RMS sum of all other spectral components, excluding DC.
h. Signal to Noise Ratio (SNR) is the ratio of the RMS value of the input signal to the RMS sum of all other spectral components, excluding harmonics and DC.
i. Total Harmonic Distortion (THD) is the ratio of the RMS value of the input signal to the RMS sum of all harmonics.
j. Spurious Free Dynamic Range (SFDR) is the ratio of the RMS full-scale range to the RMS value of the largest peak spurious component, including harmonics.

Digital Input Specifications

Table 5 lists the specifications for the digital input signals available on the Digital connector of the DT7837 module.

Table 5: Digital Input Specifications

Feature	Specifications
Number of general-purpose inputs	8
Input type	3.3 V high-speed CMOS, Schmitt trigger, 5 V tolerant
Input termination	22.1 kΩ pull-up resistor to 3.3 V
+ Voltage threshold	2.0 V typical
– Voltage threshold	0.8 V typical
Clocked with sample clock:	Yes, if the digital input port is included in the input data stream (channel/bit 7)

Digital Output Specifications

Table 5 lists the specifications for the digital output signals available on the Digital connector of the DT7837 module.

Table 6: Digital Output Specifications

Feature	Specifications
Number of general-purpose outputs	8
Output type	LVTTL
Logic high output voltage	2.4 V minimum
Logic low output voltage	0.4 V maximum
Logic high output current	–10 mA maximum
Logic low output current	4 mA maximum
Short circuit current	50 mA maximum
Clocked with sample clock	Currently not supported

Tachometer Input Specifications

Table 7 lists the specifications for the tachometer input available on the Digital connector of the DT7837 module.

Table 7: Tachometer Input Specifications

Feature	Specifications
Number of channels	1
Resolution	31 bits per channel
Input voltage range	±30 V
Threshold voltage	+2 V with 0.5 V hysteresis
Input termination	None
Maximum input frequency	1 MHz[a]
Minimum pulse width high/low (minimum amount of time it takes a C/T to recognize an input pulse)	0.4 µs
Clock frequency for tachometer measurements	12 MHz (83 ns resolution)
Overvoltage protection	±30 V
Clocked with sample clock:	Yes, if the tachometer is included in the input data stream (channel/bit 4)

a. Limited by signal integrity and input signal conditioning.

Measure Counter Specifications

Table 8 lists the specifications for the measure counter on the DT7837 module.

Table 8: Measure Counter Specifications

Feature	Specifications
Number of measure counters	1
Resolution	31 bits per channel
Clock frequency for measurement counters	48 MHz (20.8 ns resolution)
Maximum input frequency	10 MHz[a]
Minimum pulse width high/low	50 ns (0.4 µs if the tachometer input is used for the starting edge and stopping edge)
Start and stop signals/edges	A/D conversion complete Tachometer input (falling or rising edge) Digital inputs 0 to 7 (falling or rising edge) C/T 0 Clock input (falling or rising edge) C/T 0 Gate input (falling or rising edge)
Clocked with sample clock:	Yes, if the measure counter is included in the input data stream (channel/bit 6)

a. Limited by signal integrity and input signal conditioning.

General-Purpose Counter/Timer Specifications

Table 7 lists the specifications for the general-purpose counter/timer (C/T 0) on the DT7837 module.

Table 9: General-Purpose Counter/Timer Specifications

Feature	Specifications
Number of general-purpose counter/timers	1
Clock sources Internal: External:	 48 MHz reference clock General-purpose inputs 0 to 7 on the Digital connector
Gate sources Internal: External:	 Software General-purpose inputs 0 to 7 on the Digital connector
Counter/timer outputs	General-purpose outputs 11 to 18 on the Digital connector
Resolution	32 bits per channel
Clock divider Minimum: Maximum:	 2 4,294,967,296
Clock output Minimum: Maximum:	 0.0112 Hz 24 MHz
Maximum clock or gate input frequency	24 MHz[a]
Minimum pulse width (minimum amount of time it takes a C/T to recognize an input pulse)	50 ns
Input voltage range	0 to 3.3 V (+5 V tolerance)
Inputs Input logic load: High input voltage: Low input voltage: Low input current: Input termination:	 1 LVTTL 2.0 V minimum 0.8 V maximum –0.8 mA maximum 22 kΩ
Clocked with sample clock:	Yes, if the C/T is included in the input data stream (channel/bit 5)

a. The integrity of the signal degrades at frequencies greater than 10 MHz.

Trigger Specifications

Table 10 lists the specifications for the triggers on the DT7837 module.

Table 10: Trigger Specifications

Feature	DT7837 Specifications
Trigger sources Internal software trigger: External digital trigger: Threshold trigger:	 Software-initiated Software-selectable, general-purpose inputs 0 to 7 on the Digital connector Software-selectable, analog inputs 0 to 3
External trigger (digital) Trigger type: Input type: Input termination: + Voltage threshold: – Voltage threshold: Minimum pulse width high/low: Overvoltage protection:	 Edge-sensitive, rising- or falling-edge trigger (software-selectable) 3.3 V high-speed CMOS, Schmitt trigger, 5 V tolerant 22.1 kΩ pull-up resistor to 3.3 V 2.0 V 0.8 V 250 ns ±30 V
Threshold trigger Trigger type: Threshold level: Hysteresis:	 Rising- or falling-edge threshold trigger on any analog input channel (software-selectable) –10 V to +10 V @ gain of 1; ±1 V @ gain of 10 100 mV
Trigger delay	1 conversion period maximum

Master Oscillator Specifications

Table 11 lists the specifications for the master oscillator on the DT7837 module.

Table 11: Master Oscillator Specifications

Feature	Specifications
Frequency	48 MHz
Frequency stability	±30 ppm[a]

a. Stability budget consists of initial tolerance, operating temperature range, rated power supply voltage change, load change, 10-year aging, shock, and vibration.

Power, Physical, and Environmental Specifications

Table 12 lists the power, physical, and environmental specifications for the DT7837 module.

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Table 12: Power, Physical, and Environmental Specifications

Feature	DT7837 Specifications
Power	+5 VDC @ 2 A maximum
Warm-up time	1 hour
Physical Dimensions Depth: Width: Height: Weight:	 6.28 in (159.5 mm) 3.937 in (100 mm) 1.30 in (33 mm) 7.2 oz (204 g)
Environmental Operating temperature range: Storage temperature range: Relative humidity: Altitude:	 0° C to 55° C –25° C to 85° C To 95%, noncondensing To 10,000 feet

Regulatory Specifications

The DT7837 module is CE-compliant. Table 13 lists the regulatory specifications for the DT7837 module.

Table 13: Regulatory Specifications

Feature	DT7837 Specifications
Emissions (EMI)	FCC Part 15, Class A EN55011:2007 (Based on CISPR-11, 2003/A2, 2006)
Immunity	EN61326-1:2006 Electrical Equipment for Measurement, Control, and Laboratory Use EMC Requirements EN61000-4-2:2009 Electrostatic Discharge (ESD) 4 kV contact discharge, 8 kV air discharge, 4 kV horizontal and vertical coupling planes EN61000-4-3:2006 Radiated electromagnetic fields, 3 V/m, 80 to 1000 MHz; 3 V/m, 1.4 GHz to 2 GHz; 1 V/m, 2 GHz to 2.7 GHz EN61000-4-4:2004 Electrical Fast Transient/Burst (EFT) 1 kV on data cables EN61000-4-6:2009 Conducted immunity requirements, 3 Vrms on data cables 150 kHz to 80 MHz
RoHS (EU Directive 2002/95/EG)	Compliant (as of July 1st, 2006)
Safety	UL, CSA

Connector Specifications

Table 14 lists the connector specifications for the DT7837 module.

Table 14: Connector Specifications

Connector	Board Reference Designator [a]	Part Number of Connector on Module	Part Number of Mating Connector
Analog input SMA connectors	J1-J5 on I/O block	Amphenol Connex 132203	–
Ethernet (RJ45) connector	J1 on ARM block	Bothhand LU1S041C-43 LF	–
USB host connector	J2 on ARM block	TE Connectivity 292336-1	–
USB device (client) connector	J4 on ARM block	TE Connectivity 292304-2	–
MicroSD connector	J5 on ARM block	Molex 503182-1853	–
External power supply DIN connector: 3-Pin header:	 J6 on ARM block TB1 on ARM block	 Kycon KPJX-4S-S Phoenix Contact 1707434	 Kycon KPPX-4P Phoenix Contact 1839610
Digital connector	J8 on ARM block	TE Connectivity 5499786-6	–
Serial connectors[b]	J12, J13, and J14 on ARM block	FCI 68000-406HLF	–

a. The reference designator indicates the location of the connector on the board. The ARM block is the bottom board and the I/O block is the top board.

b. The optional EP405 USB to Serial TTL cable attaches to connector J13 and the USB port of your computer.

External Power Supply Specifications

Table 15 lists the specifications for the option EP361 +5 V external power supply that is used with the DIN power connector on the DT7837 module.

Table 15: Specifications for the Optional EP361 External Power Supply Used with the DIN Connector on the DT7837 Module

Feature	Specifications
Type	Total Power medical power supply (TPEMG24-S050400-7)
Input voltage	Typical 90 - 264 V AC
Input current	Typical 0.347 A at 115 V AC, 0.215 A at 230 V AC
Frequency	47 to 63 Hz
Inrush current	6.274 A RMS at 230 V AC
Output voltage	5 V DC
Output current	4.0 A
Output wattage	Typical 20 - 24 W
Noise and ripple	1% peak to peak
Regulatory specifications	UL, ITE, CE, FCC Class B, Energy Star compliant

Table 16 lists the specifications for the external power supply that is used with the 3-position header on the DT7837 module.

Table 16: Specifications for the External Power Supply Used with the 3-Position Header on the DT7837 Module

Feature	Specifications
Output voltage	5 VDC to
Output current	2 A with 4 A surge capability
Noise and ripple	50 mVpp

B

Connector Pin Assignments and LED Status Indicators

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Digital Connector 77
USB Device (Client) Connector 79
USB Host Connector 80
Ethernet Connector 81
Micro SD Card Connector 82
External +5 V Power Connector 83
Serial Connectors 85
I/O Block Connector 88
STP26 Screw Terminal Panel 91
LED Status Indicators 93

Analog Input Connectors

Figure 13 shows the layout of the analog input SMA connectors (connectors J1-J5) on the I/O block (top board) of the DT7837 module.

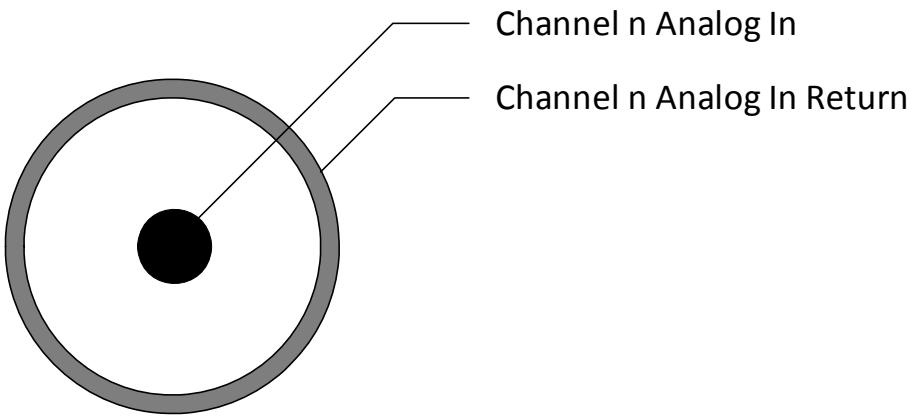


Figure 13: Analog Input Connectors

Digital Connector

Figure 14 shows the layout of the 26-pin Digital connector (J8) on the ARM block (bottom board) of the DT7837 module. This connector brings out the tachometer, GPIO, and event output signals for the module.

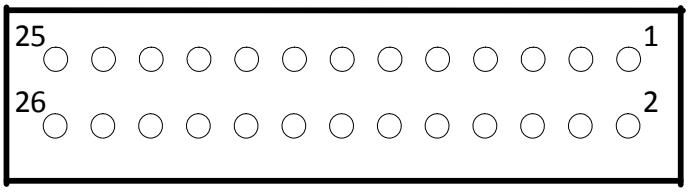


Figure 14: Layout of the Digital Connector

Table 17 lists the pin assignments for the Digital connector on the DT7837 module.

Table 17: Pin Assignments for the Digital Connector

Connector Pin Number	Signal Description	Connector Pin Number	Signal Description
1	General Purpose Input 0[a]	14	General Purpose Output 3[b]
2	General Purpose Input 1[a]	15	General Purpose Output 4[b]
3	General Purpose Input 2[a]	16	General Purpose Output 5[b]
4	General Purpose Input 3[a]	17	General Purpose Output 6[b]
5	General Purpose Input 4[a]	18	General Purpose Output 7[b]
6	General Purpose Input 5[a]	19	Digital Ground
7	General Purpose Input 6[a]	20	Digital Ground
8	General Purpose Input 7[a]	21	Event Out (currently not supported)
9	Digital Ground	22	Digital Ground
10	Digital Ground	23	Tachometer input
11	General Purpose Output 0[b]	24	Digital Ground
12	General Purpose Output 1[b]	25	+5 V
13	General Purpose Output 2[b]	26	Digital Ground

a. The input signals are +5 V tolerant and 22 kΩ pull-ups are provided. By default, they are configured as digital input signals. By default, these signals are configured as digital input signals.
b. The output signals are driven by LVTTL buffers and are capable of providing up to ±24 mA of drive current at standard LVTTL levels. By default, they are configured as digital output signals. By default, these signals are configured as digital output signals.

Using software, you can specify a general-purpose input signal as the signal source for the following destinations:

- Digital input (the default signal for each general-purpose input pin)
- External A/D trigger input
- Gate input for the general-purpose counter/timer (C/T 0)
- Clock input for the general-purpose counter/timer (C/T 0)

Using software, you can specify a general-purpose output signal as the signal source for one of these destinations:

- Digital output (the default signal for each general-purpose output pin)
- Clock output for the general-purpose counter/timer (C/T 0)

Note that a single general-purpose input may drive several destinations at the same time. However, a single general-purpose output can have only one driving source.

USB Device (Client) Connector

Figure 15 shows the layout of the USB device (client) connector (J4) on the ARM block (bottom board) of the DT7837 module. This is a type B connector.

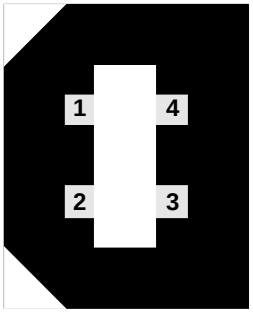


Figure 15: Layout of the USB Type B Connector for the USB Device (Client) Port

Table 18 lists the pin assignments for the USB type B connector on the DT7837 module for the USB device (client) port.

Table 18: Pin Assignments for the USB Type B Connector for the USB Device (Client) Port

Connector Pin Number	Signal Description	Connector Pin Number	Signal Description
1	USB +5 V	3	USB Data +
2	USB Data –	4	USB Ground

Note: The outer shell provides cable shield to chassis ground.

USB Host Connector

Figure 15 shows the layout of the USB host connector (J2) on the ARM block (bottom board) of the DT7837 module. This is a type A connector.

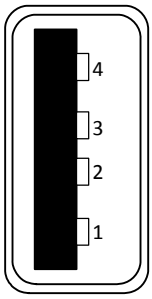


Figure 16: Layout of the USB Type A Connector for the USB Host Port

Table 19 lists the pin assignments for the USB type A connector on the DT7837 module for the USB host port.

Table 19: Pin Assignments for the USB Type B Connector for the USB Device (Client) Port

Connector Pin Number	Signal Description	Connector Pin Number	Signal Description
1	USB +5 V	3	USB Data +
2	USB Data –	4	USB Ground

Note: The outer shell provides cable shield to chassis ground.

Ethernet Connector

Figure 15 shows the layout of the Ethernet (RJ45) connector (J1) on the ARM block (bottom board) of the DT7837 module.

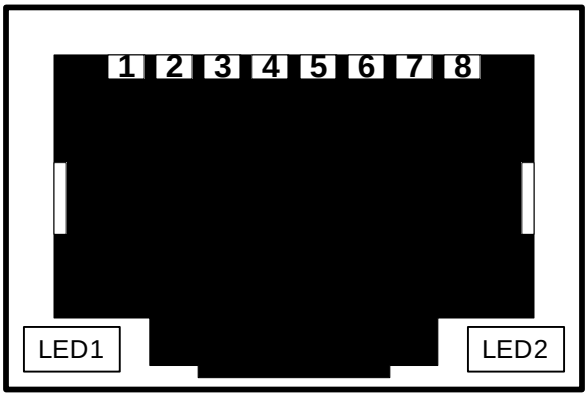


Figure 17: Layout of the Ethernet Connector

Table 20 lists the pin assignments for the Ethernet connector on the DT7837 module.

Table 20: Pin Assignments for the Ethernet Connector

Connector Pin Number	Signal Description	Connector Pin Number	Signal Description
1	Transmit+	5	Not connected
2	Transmit–	6	Receive–
3	Receive+	7	Not connected
4	Not connected	8	Not connected
LED1	Activity (green)	LED2	Link (yellow)

Note: The outer shell provides cable shield to chassis ground.

Micro SD Card Connector

Figure 18 shows the layout of the Micro SD Card connector (J5) on the ARM block (bottom board) of the DT7837 module.

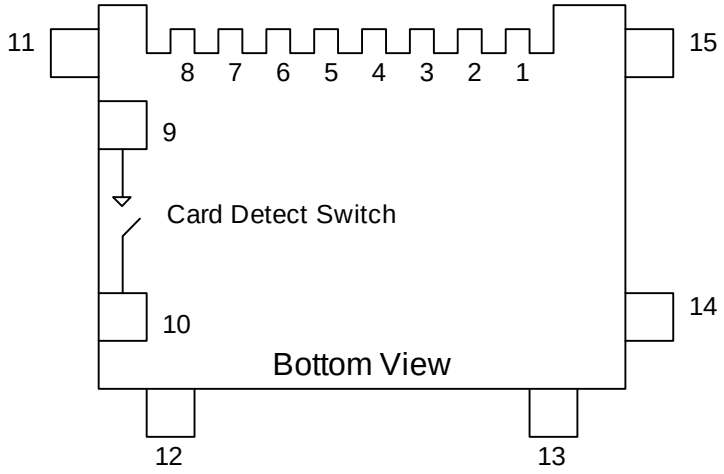


Figure 18: Micro SD Card Connector

Table 21 lists the pin assignments for the Micro SD card connector on the DT7837 module.

Table 21: Pin Assignments for the Micro SD Card Connector

Connector Pin Number	Signal Description	Connector Pin Number	Signal Description
1	DAT2	9	CD
2	DAT3/CD	10	DGND
3	CMD	11	CGND
4	+3.3 V	12	CGND
5	CLK	13	CGND
6	DGND	14	CGND
7	DAT0	15	CGND
8	DAT1		

External +5 V Power Connector

The DT7837 module provides two connectors for attaching a +5 VDC external power supply: a DIN connector and a 3-position Phoenix header.

Figure 19 shows the layout of the DIN power connector (J6) on the ARM block (bottom board) of the DT7837.

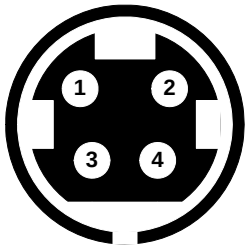


Figure 19: Layout of the DIN Power Connector

Table 22 lists the pin assignments for the external DIN power connector on the DT7837 module.

Table 22: Pin Assignments for the External Power Connector

Connector Pin Number	Signal Description	Connector Pin Number	Signal Description
1	+5 VDC	2	+5 VDC
3	Ground	4	Ground

You can connect the optional EP361 power supply to the DIN connector, if desired. Refer to page 72 and page 73 for detailed specifications of this power supply.

Figure 20 shows the layout of the 3-pin Phoenix header (TB1) on the ARM block (bottom board) of the DT7837 module.

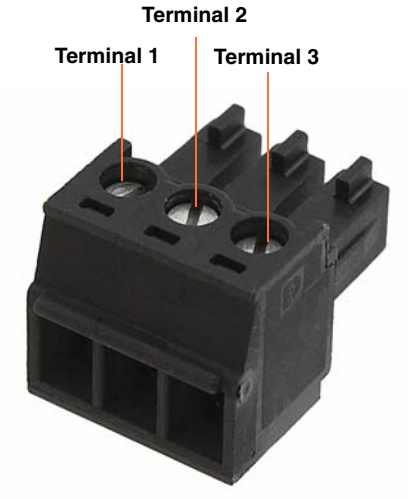


Figure 20: Layout of the 3-Position Phoenix Header

Table 23 lists the terminal assignments for the 3-position header on the DT7837 module.

Table 23: Terminal Assignments for the 3-Position Header (TB1) on the DT7837 Module

Terminal Number	Signal Description
1	+5 VDC
2	Digital Ground
3	Chassis Ground

Note that you must connect an external power supply to this header that meets the specifications described on page 74.

Serial Connectors

Figure 15 shows the layout of the 6-pin serial connectors (J12, J13, and J14) on the ARM block (bottom board) of the DT7837 module.

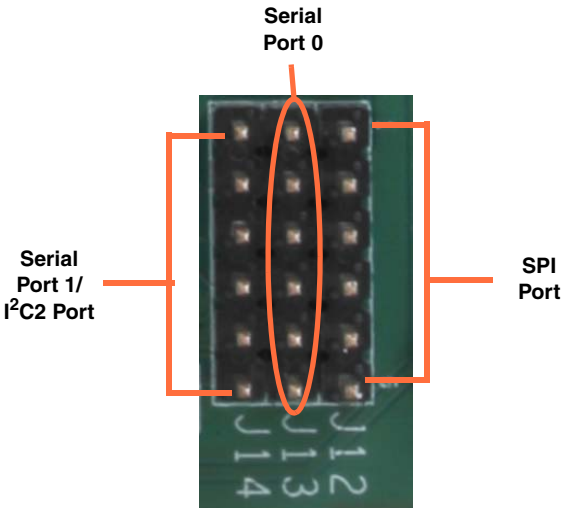
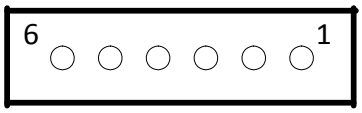


Figure 21: Layout of the Serial Connectors

These connectors are described in the sections that follow.

Serial Port 0 (UART 0)

Figure 15 shows the layout of the Serial port 0 (J13) on the ARM block (bottom board) of the DT7837 module.



***Note that the pin order of connector J13 is reversed from connectors J12 and J14.**

Figure 22: Layout of Serial Port 0 (J13)

Table 24 lists the pin assignments for serial port 0 on the DT7837 module.

Table 24: Pin Assignments for Serial Port 0 (J13) on the DT7837 Module

Connector Pin Number	Signal Description
1	DGND
2	Not Connected
3	Not Connected
4	UART0_RX
5	UART0_TX
6	Not Connected

SPI Connector

Figure 15 shows the layout of the SPI connector (J12) on the ARM block (bottom board) of the DT7837 module.

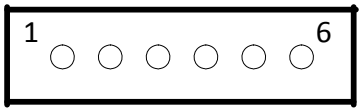


Figure 23: Layout of SPI Connector (J12)

Table 25 lists the pin assignments for the SPI connector on the DT7837 module.

Table 25: Pin Assignments for SPI Connector (J12) on the DT7837 Module

Pin Number	Signal Description
1	SPI1_D0
2	SPI1_SCLK
3	SPI1_CS0
4	SPI1_D1
5	DGND
6	+3.3 V

Serial Port 1 / I²C2 Connector

Figure 15 shows the layout of the Serial port 1/ I²C2 connector (J14) on the ARM block (bottom board) of the DT7837 module.

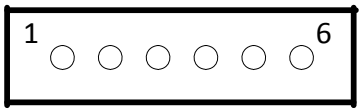


Figure 24: Layout of Serial Port 1 / I²C Port (J14)

Table 26 lists the pin assignments for the Serial port 1/ I²C connector on the DT7837 module.

Table 26: Pin Assignments for Serial Port 1 / I²C Connector (J14) on the DT7837 Module

Pin Number	Signal Description
1	UART1_RX
2	UART1_TX
3	I²C2_SDA
4	I²C2_SCL
5	DGND
6	+3.3 V

I/O Block Connector

Figure 15 shows the layout of the I/O block connector (J9) on the DT7837 module.

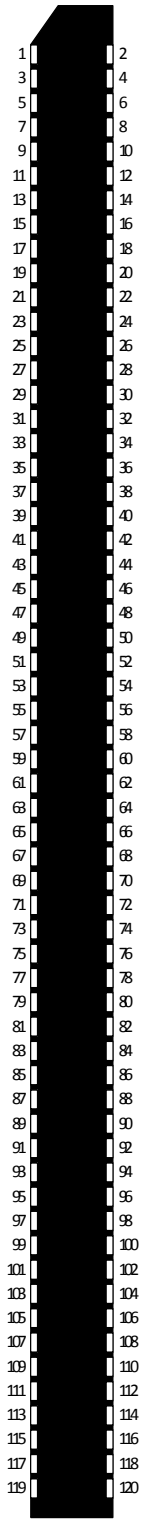


Figure 25: I/O Block Connector (J9)

Table 27 lists the pin assignments of the I/O block connector on the DT7837 module (on both the ARM block and the I/O block).

Table 27: Pin Assignments for the I/O Block Connector (J9)

Connector Pin Number	Signal Description	Connector Pin Number	Signal Description
1	+5 V	2	+5 V
3	+5 V	4	+5 V
5	Ground	6	Ground
7	Ground	8	Ground
9	Test 0	10	Test 1
11	Test 2	12	Test 3
13	LED 0	14	LED 1
15	LED 2	16	LED 3
17	LED 4	18	LED 5
19	LED 6	20	LED 7
21	DC/DC Sync 0	22	DC/DC Sync 1
23	Ground	24	Ground
25	I^2C SLC 0	26	I^2C SLC 1
27	I^2C SDA 0	28	I^2C SDA 1
29	Ground	30	Ground
31	Write Enable 0	32	Write Enable 1
33	Read Enable 0	34	Read Enable 1
35	In Sync Control 0	36	In Sync Control 1
37	In Sync Control 2	38	In Sync Control 3
39	Ground	40	Ground
41	DAQ Clock 0	42	DAQ Clock 1
43	DAQ Clock 2	44	DAQ Clock 3
45	Ground	46	Ground
47	Sync 0	48	Sync 1
49	Data Clock 0	50	Data Clock 1
51	Data Clock 2	52	Data Clock 3
53	Ground	54	Ground
55	In Serial Data 0	56	In Serial Data 1
57	In Serial Data 2	58	In Serial Data 3

Table 27: Pin Assignments for the I/O Block Connector (J9)

Connector Pin Number	Signal Description	Connector Pin Number	Signal Description
59	In Serial Data 4	50	In Serial Data 5
61	In Serial Data 6	62	In Serial Data 7
63	Ground	64	Ground
65	In Parallel Data 0	66	In Parallel Data 1
67	In Parallel Data 2	68	In Parallel Data 3
69	In Parallel Data 4	70	In Parallel Data 5
71	In Parallel Data 6	72	In Parallel Data 7
73	Ground	74	Ground
75	Control 0	76	Control 1
77	Control 2	78	Control 3
79	Control 4	80	Control 5
81	Control 6	82	Control 7
83	Ground	84	Ground
85	Control 8	86	Control 9
87	Control 10	88	Control 11
89	Control 12	90	Control 13
91	Control 14	92	Control 15
93	Ground	94	Ground
95	Out Parallel Data 0	96	Out Parallel Data 1
97	Out Parallel Data 2	98	Out Parallel Data 3
99	Out Parallel Data 4	100	Out Parallel Data 5
101	Out Parallel Data 6	102	Out Parallel Data 7
103	Ground	104	Ground
105	Out Serial Data 0	106	Out Serial Data 1
107	Out Serial Data 2	108	Out Serial Data 3
109	Out Serial Data 4	110	Out Serial Data 5
111	Out Serial Data 6	112	Out Serial Data 7
113	Ground	114	Ground
115	Out Sync Control 0	116	Out Sync Control 1
117	Out Sync Control 2	118	Out Sync Control 3
119	Ground	120	Ground

STP26 Screw Terminal Panel

The STP26 contains one 26-pin connector and a screw terminal block (TB1). The 26-pin connector provides access to the signals from the Digital connector on the DT7837 module.

Figure 26 shows the layout of the STP26 screw terminal panel.

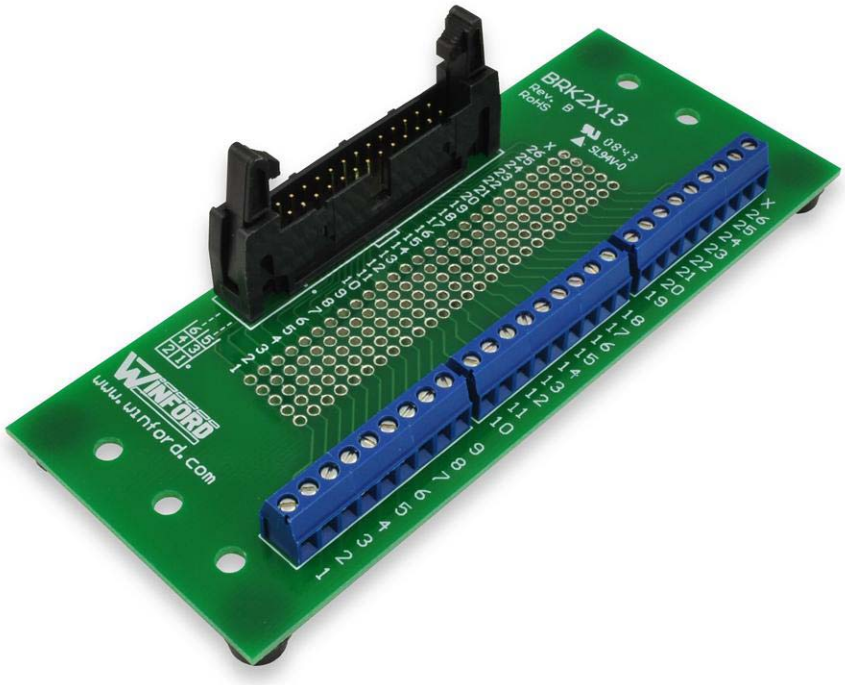


Figure 26: Layout of the STP26 Screw Terminal Panel

Table 28 lists the screw terminal assignments for the STP26 screw terminal panel.

Table 28: Screw Terminal Assignments for the STP26 Screw Terminal Panel

Screw Terminal	Signal Description
X	Shield
26	Digital Ground
25	+5 V
24	Digital Ground
23	Tachometer Input
22	Digital Ground
21	Reserved for future use
20	Digital Ground
19	Digital Ground
18	General-Purpose Output 7
17	General-Purpose Output 6
16	General-Purpose Output 5
15	General-Purpose Output 4
14	General-Purpose Output 3
13	General-Purpose Output 2
12	General-Purpose Output 1
11	General-Purpose Output 0
10	Digital Ground
9	Digital Ground
8	General-Purpose Input 7
7	General-Purpose Input 6
6	General-Purpose Input 5
5	General-Purpose Input 4
4	General-Purpose Input 3
3	General-Purpose Input 2
2	General-Purpose Input 1
1	General-Purpose Input 0

LED Status Indicators

The DT7837 module has a Power LED indicator on the ARM block (bottom board) and trigger LEDs on the I/O block (top board), as shown in Figure 27.

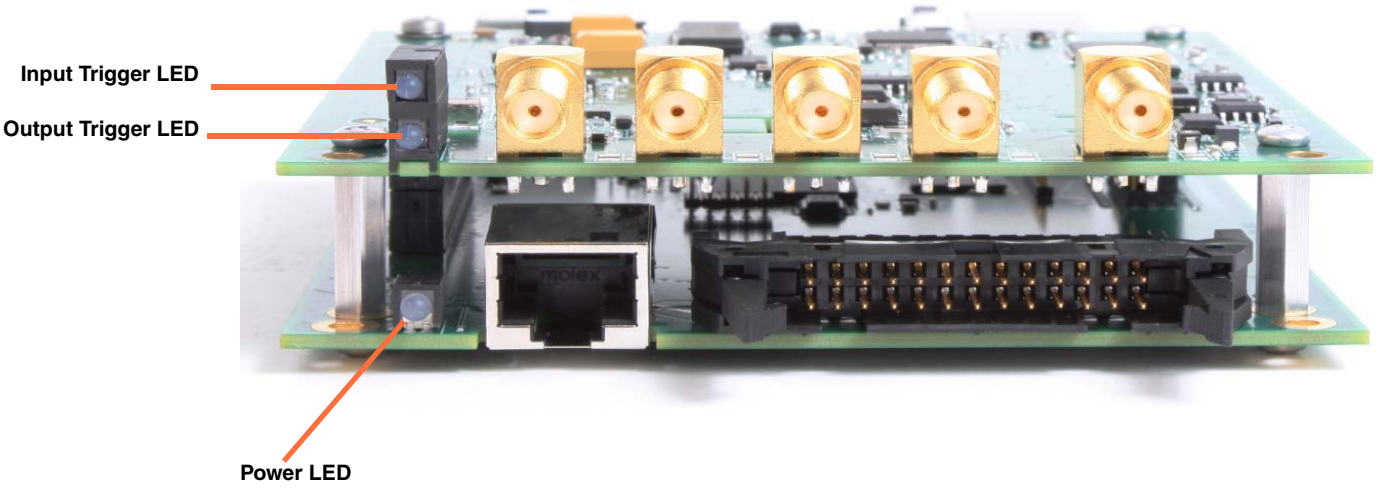


Figure 27: Power LED on the DT7837 Module

These LEDs are described in Table 29.

Table 29: LED Status Indicators on the DT7837 Module

LED	Color of the LED	Status Description
Input Trigger LED	Off	Idle.
	Solid amber	Input subsystem armed; it is waiting for an external digital trigger or threshold trigger (the module must have been configured for one of these trigger types).
	Solid green	Input subsystem has been triggered.
Output Trigger LED	Off	Idle.
	Solid amber	Output subsystem armed; it is waiting for an external digital trigger or threshold trigger (the module must have been configured for one of these trigger types).
	Solid green	Output subsystem has been triggered.
Power LED	Off	Power off.
	Solid green	Power on.

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